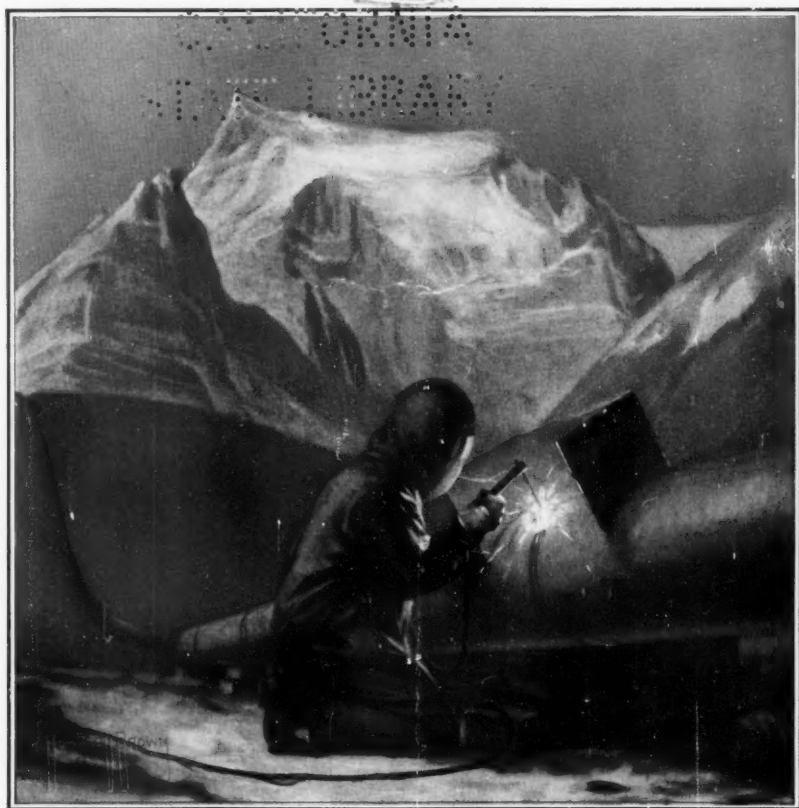


SCIENTIFIC AMERICAN

July 1929

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MANUFACTURED WEATHER

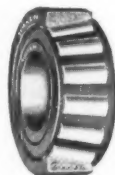
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Cadillac.....	All	.X.	.X.	.X.	.X.	.X.
Chrysler.....	De Soto	.X.	.X.	.X.	.X.	.X.
	Plymouth	.X.	.X.	.X.	.X.	.X.
	65 & 75	.X.	.X.	.X.	.X.	.X.
	Imperial	.X.	.X.	.X.	.X.	.X.
Cunningham....	All	.X.	.X.	.X.	.X.	.X.
Dodge.....	All	.X.	.X.	.X.	.X.	.X.
Durant.....	40, 60, 66	.X.	.X.	.X.	.X.	.X.
	70	.X.	.X.	.X.	.X.	.X.
Elcar.....	75	.X.	.X.	.X.	.X.	.X.
	95, 96, 120	.X.	.X.	.X.	.X.	.X.
Ford.....	All	.X.	.X.	.X.	.X.	.X.
Franklin.....	All	.X.	.X.	.X.	.X.	.X.
Gardner.....	All	.X.	.X.	.X.	.X.	.X.
Graham Paige..	612	.X.	.X.	.X.	.X.	.X.
	615	.X.	.X.	.X.	.X.	.X.
	621, 827, 837	.X.	.X.	.X.	.X.	.X.
Hudson and Essex	All	.X.	.X.	.X.	.X.	.X.
Hupmobile.....	Century 6	.X.	.X.	.X.	.X.	.X.
	Century 8	.X.	.X.	.X.	.X.	.X.
Jordan.....	All	.X.	.X.	.X.	.X.	.X.
Kissel.....	75 & 95	.X.	.X.	.X.	.X.	.X.
	126	.X.	.X.	.X.	.X.	.X.
Kletzer.....	All	.X.	.X.	.X.	.X.	.X.
LaSalle.....	All	.X.	.X.	.X.	.X.	.X.
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	68	.X.	.X.	.X.	.X.	.X.
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	Roosevelt	.X.	.X.	.X.	.X.	.X.
McFarlan.....	All	.X.	.X.	.X.	.X.	.X.
Moon.....	All	.X.	.X.	.X.	.X.	.X.
Nash.....	Std 6	.X.	.X.	.X.	.X.	.X.
Peerless.....	All	.X.	.X.	.X.	.X.	.X.
Pierce-Arrow....	All	.X.	.X.	.X.	.X.	.X.
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Roamer.....	All	.X.	.X.	.X.	.X.	.X.
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and Erskine...	All	.X.	.X.	.X.	.X.	.X.
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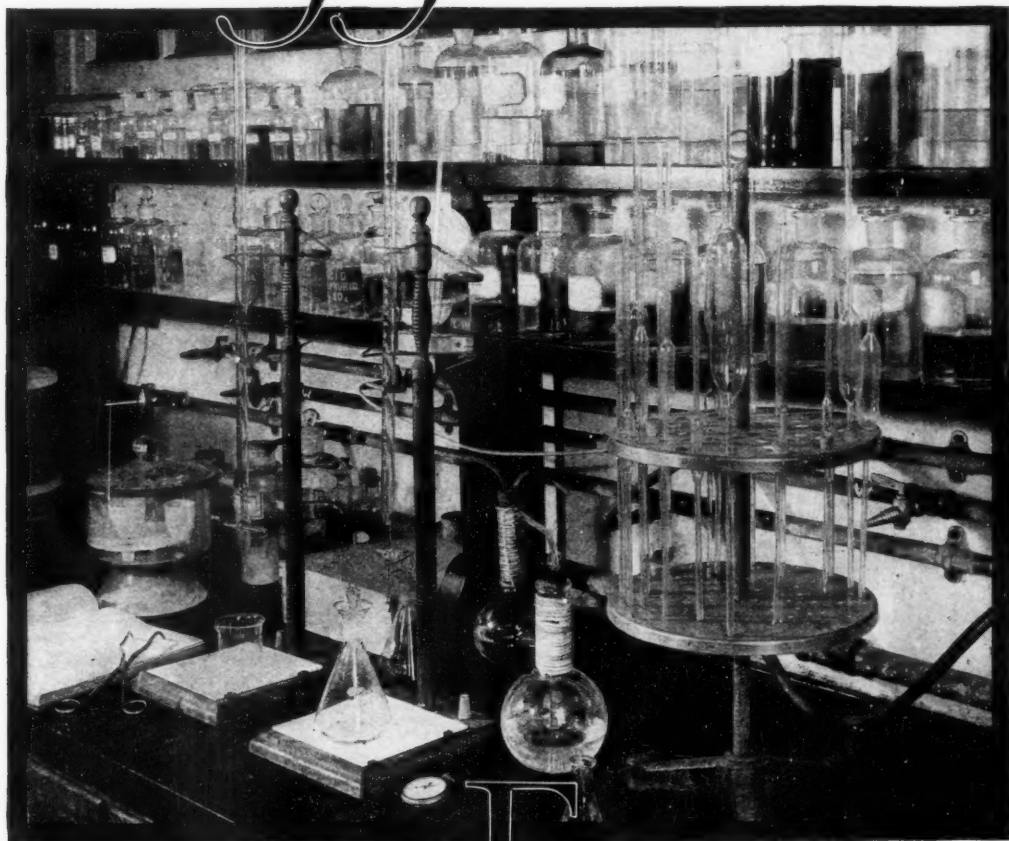
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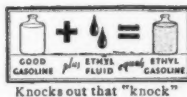
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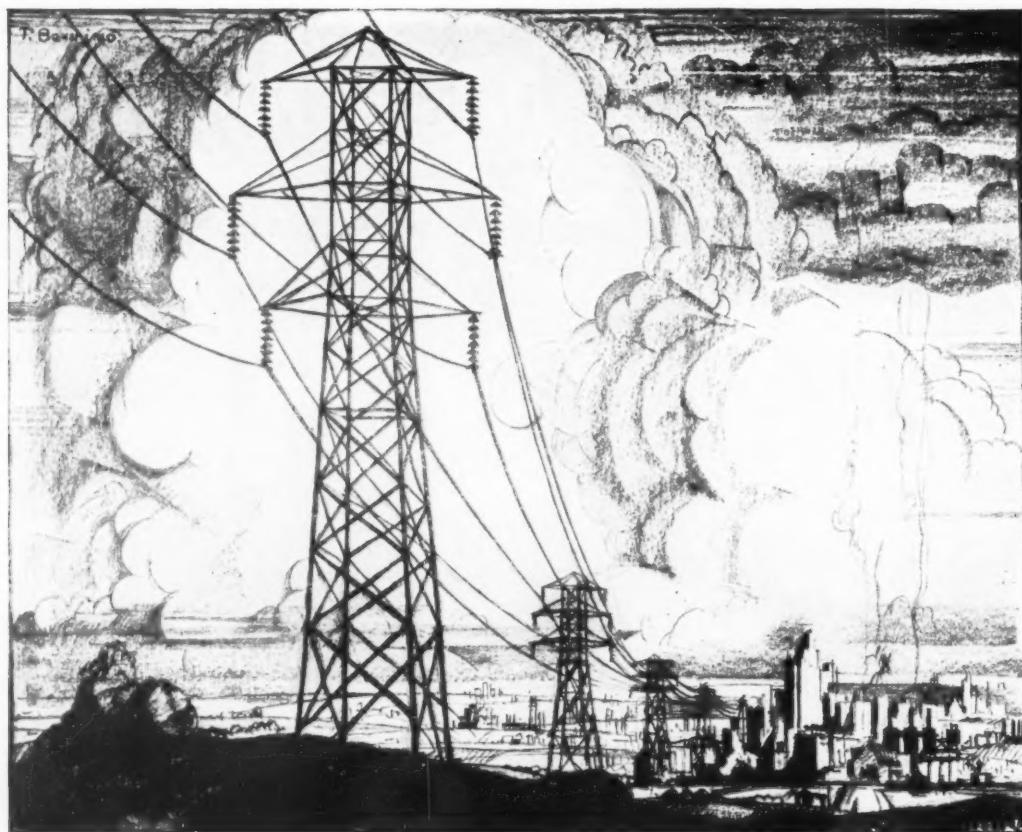


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SCIENTIFIC AMERICAN

24 WEST 40th STREET

NEW YORK CITY

July 1929

Edited by ORSON D. MUNN

Eighty-fifth Year

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COVER

In the construction of long pipelines for gas and oil, see page 43, powerful generating plants are often transported to the scene of operation to supply the current for arc welding. Our artist has faithfully depicted a welder at work in the shadow of tall mountains.

Inventions and Patents

Their Development and Promotion

By Milton Wright

SO many pitfalls lie in wait for the inventor and so often the lack of proper information at the right time has beclouded the patent situation, that the value of the patent to the owner has been hopelessly diminished. This book was written for the layman, anyone can understand it, and by following its instruction full protection and reward is assured.

Postpaid \$2.65

Amateur Telescope Making

Albert G. Ingalls, Editor

ALL over the world telescopes are being built from the explicit instructions contained in this, the only authoritative work on the subject. It is a compendium of all available information and much of it is by authorities recognized throughout science as the most eminent in their line. The presentation is as simple and informal as it is possible to make it.

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Guide to the Constellations

By Barton & Barton

WARM summer nights when the stars seem to stand out particularly in the sky, will be full of added beauty and exaltation if one is familiar with this guide which shows by maps and description just where to find the wonders of the heavens without the aid of an opera glass or any other attendant instrument.

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For Sale by SCIENTIFIC AMERICAN

Looking Ahead With the Editor

Natural History for August

DURING vacation time the myriad miracles and wonders of nature call, and an army of city dwellers will take the trail to the great outdoors. For those who go and the stay-at-homes, our August issue will be devoted largely to natural history. In that issue you will find an article on the great reindeer industry and another concerning the loon. The shedding of antlers and the growth of a new set by the wapiti deer will be described and fully illustrated. Stories about wary mountain goats; fungi that kill mosquitoes, silkworms, fishes, et cetera; the gigantic problem of controlling our insect pests; and one which dispels many fallacies about snakes, round out the list. Look for other fine articles.

The Scarcely Known Diatom

IF someone should tell you that a very great number of the articles you use daily contain diatoms, you'd probably be puzzled. Ten thousand chances to one you've never heard of these microscopic forms of life. What diatoms are, how they live, how their fossils have formed great deposits, and the innumerable uses now found for them, constitute the theme of a coming article that will interest every one—because diatoms are even in the tooth paste we all use several times daily.

The Trail Breakers

IMAGINE your car stuck in the mud of darkest Africa—it is night, and the headlights are reflected in the eyes of stalking lions. Imagine driving only two miles a day through jungles. Imagine—but you *can't* imagine the thrilling adventures and the nerve-racking experiences of the two daring men who blazed a motor trail over the route the empire-builder, Cecil Rhodes, hoped to build a railroad, from Cape Town to Cairo—not until you've read the story of the trip, written by one of the trail breakers, which we shall publish soon.

The Old Rubber Cow

THIS intriguing nickname, which means nothing to you perhaps, was applied by war-time flyers—not so affectionately, either—to the small and dangerously slow “limp” dirigible, the blimp, which was used for scouting and observation. Airplanes and rigid dirigibles have eclipsed it somewhat in recent years but it has tremendous possibilities in commercial service, as pointed out by an authority in a forthcoming article.

Every Issue Fully Illustrated

The well-informed man or woman is the one who progresses. Why not let the SCIENTIFIC AMERICAN bring to you the latest news of the scientific world in general? The cost is nominal—only four dollars for an entire year's subscription.

Among Our Contributors

Lady Mary Heath



It is scarcely necessary to introduce Lady Mary Heath to our readers for her name has occupied a prominent place in the news of aviation in every American newspaper. She is of that small but growing group of daring women who have taken up aviation as a profession as well as a sport, and has made some notable flights. She is active in the aviation industry in America.

William Alphonso Murrill

For many years Assistant Director of the New York Botanical Gardens, Dr. Murrill is widely known as an explorer, lecturer, and writer. He has collected over 50,000 scientific specimens; has discovered and named 1000 new plant species; and has published hundreds of scientific papers and books.

Donald A. Laird

Dr. Laird is Director of the Psychological Laboratory at Colgate University where much stress is put on “sike” and every student is required to study it before graduation. He also edits the well-known journal *Industrial Psychology*. He has a very happy style of popularizing psychology because he knows just what the average reader wants. Thus his articles never lack interest for the layman.



Annie S. Peck

Few people have a knowledge of South America to compare with that of Miss Peck, for she has explored the continent thoroughly. Over 20 years ago she was the first to climb Peru's highest peak and Peru honored her for the feat by naming the peak “Cumbre Ana Peck.” Miss Peck has written several books on South America.

Richard Ruedy

Dr. Ruedy is a consulting engineer of Toronto who previously conducted a great deal of research on the ultra-violet at one of the large Canadian Universities. He was formerly connected with the research laboratory of the National Electric Lamp Works of the General Electrical Company, Cleveland.

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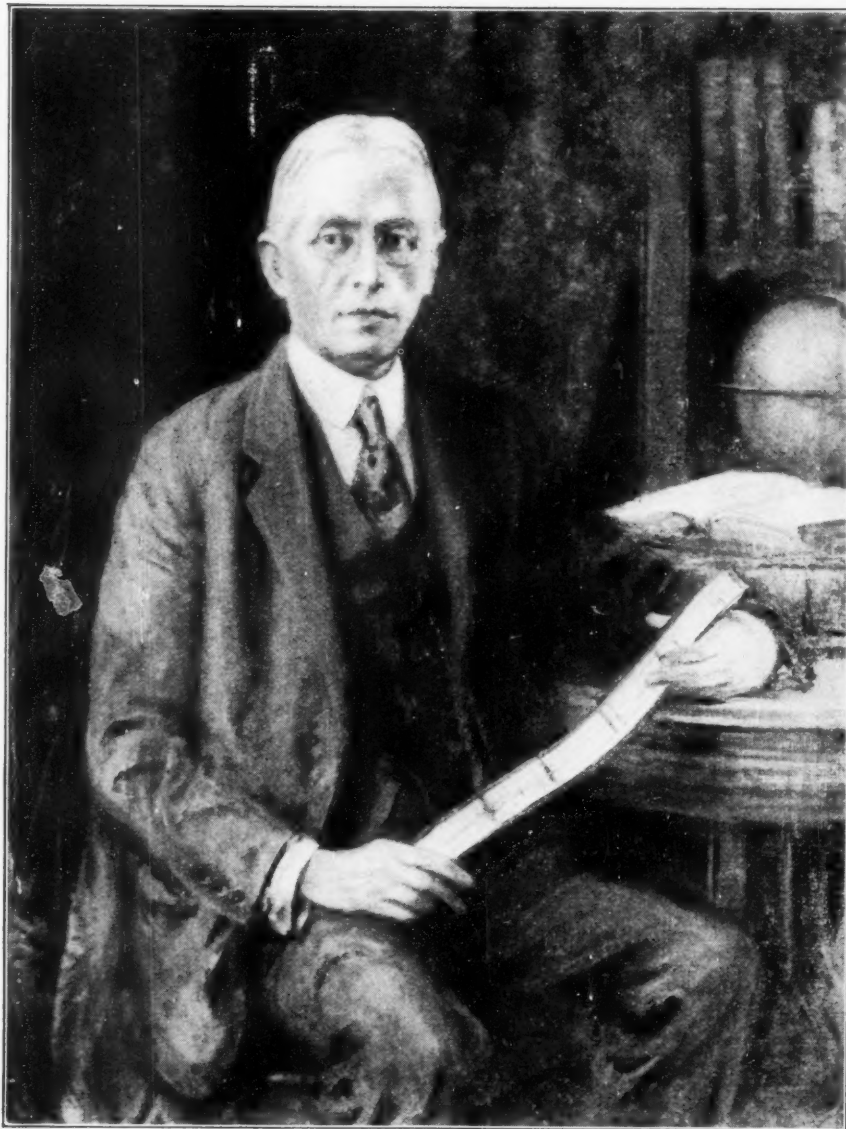
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TRIAL—FOUR MONTHS—ONE DOLLAR



Henry Norris Russell

THOSE who regularly read in this journal the monthly articles by Professor Henry Norris Russell, on the current advances of astronomy, will be especially interested in the portrait reproduced above. It was painted by Samuel M. Palmer of Philadelphia, and presented to Princeton University by the Class of 1897, on the recent occasion of the endowment by that class of a research professorship of astronomy, the first holder of which will be Dr. Russell. Both artist and subject are also members of that notable graduating class. The re-

production was obtained from Princeton University by the editor. In the portrait Dr. Russell is shown holding a sunspot spectrogram. Dr. Russell's connection with the SCIENTIFIC AMERICAN began about 30 years ago, when he was an obscure graduate student at Princeton. In his first article he struck the vein desired by the editor, and so began a relationship which it is hoped will continue many more years. He is now recognized among scientists, both here and in Europe, as one of perhaps five of the foremost astronomers of the world



Slashes In the Mountainside

THE path of progress is literally a steep one in the case of the project for building a highway to the sea undertaken by the Department of Antioquia, Colombia. Above is shown a completed section of the road which, when completed, will bring the capital city of this productive department within a few hours' traveling distance of its new seaport.

This section was cut through the solid rock of Little Pass, or Boqueroncito, only a short distance from the prosperous capital city, Medellin. The fall to the left of the road is nearly 3000 feet. In the distance to the left is a continuation of the road on a lower level. Up to five tons of dynamite were used in single shots here. See the article on opposite page.



A PLATEAU CITY FRAGRANT WITH SCENT OF COFFEE BLOSSOMS

A section of the city of Medellin, capital of the Department of Antioquia, Colombia, from which the new highway runs northward through Boqueron de San Cristobal, the gap at the left. The city is the center of a mining and agricultural region

From Colombian Mountains to the Sea

A Rich Hinterland of Colombia, Seeking Independence of its Old Slow Transportation System, Builds a Road to the Sea

By F. D. McHUGH

TO the sea! To the sea! We want to go to the sea!" The cry went up from a modern city of 100,000 people, a city almost isolated by mountains through which it was impracticable to build a railroad, a city that, for all its progressiveness and importance, still was forced to ship its products and bring in necessities from the outside world by a transportation system that was as costly and uncertain as it was slow.

"We want to go to the sea!" One heard it at the clubs where prosperous business men meet, over one's demitasse, in exclusive shops and little shops, on the streets, everywhere; it rose in a crescendo of hope that shadowed lesser ambitions, that transcended political issues. *Carretera al Mar!* The highway to the sea! Posters encouraged it; placards on automobiles urged it; everyone demanded it. *Al Mar* came to be a synonym for patriotism, *Carretera al Mar* a synonym for progress. Thus Medellin, capital city of the Department of Antioquia, Colombia, South America, voiced its determination to build a road to the sea, a road that would mark fulfillment of a long-cherished hope, a road that would give independence of an antiquated transportation system little better than that used by the old Spanish conquistadores. *Carretera al Mar!* The cry resounded through the hills and the echo, answering back, seemed

like some age-old cry of anguish, like a battle-cry of the conquistadores themselves, the yearning cry for freedom. The highway to the sea would release Medellin, center of a vast productive district, from the difficulties that had retarded its full development through the centuries.

In an age when almost every major engineering project is heralded as symbolic of modern progress, the highway that is now being built by the Department of Antioquia stands incomparably high in romance. An engineering feat of first magnitude, it also represents the consummation of an ideal, the very soul of a people.

Strangely enough, the fact that a river which is subject to dry spells was dry for a longer period than it had been previously for years furnished the immediate impulse for the beginning of this great enterprise. And now the people of Antioquia and of its capital, Medellin, may point with pride to the completion in August of the first 100 miles of this highway.

Somnolent Colombia came to the realization following the World War that she possessed a great abundance of natural resources of which she had not previously taken full advantage. In possession of these, she is more nearly



SOON TO LOSE THEIR JOBS

Pack animals have been used for centuries in Colombia. Those shown here are bringing in a knocked-down motor truck to be used by the contractors. The road will serve a large area



Photographs courtesy R. W. Hebard and Company, Inc.

WINDING LIKE A MAZE ALONG THE MOUNTAIN SIDES

The inscription on the back of this photograph reads: "A turn on the—" A turn! This is typical of the topography of the country in which the new highway to the sea is being built

comparable to the United States than is any other Central or South American country. She has iron, coal, gold, silver, platinum, emeralds, and many other things of lesser importance. In the production of platinum and emeralds she now leads the world.

COFFEE is the most important agricultural crop of Colombia, her annual production of this commodity being second only to that of Brazil. Despite her rugged topography, she is also a large producer of such staples as wheat, corn, sugar, cotton, and bananas. Cattle raising flourishes in the lowlands near the coast.

Although Colombia has a population of only about 8,000,000, she has an area of almost a half million square miles, or what amounts to almost one sixth the area of continental United States, or more than the combined areas of Germany, Denmark, Norway, and Sweden. Strategically situated, from a commercial point of view, in the northwestern corner of South America abutting on Panama, she is the only South American country touching on both the Atlantic and Pacific Oceans. She is fortunate, too, in having a wide range of climates, from the cooler temperatures of the mountains to hot, tropical sections on the Caribbean Sea and in the lowlands near the equator.

Needless to say, a country of such great size with so small a population, a desirable climatic range, and such vast natural resources, promises to become a vital factor in future world economies. Realizing that fact, Colombia has progressed greatly in recent years, has doubled her coffee production in 10

years, has taken the lead from Russia in the production of platinum, and is actively engaged in increasing her production of other staples. Her laudable plans for the future are entirely within reason for the native whites are industrious people who are still old-fashioned enough to have large families. It is not at all uncommon to find Colombian families of from 14 to 16 children, all of whom are hard workers. Colombia also has some Indians and Negroes. As for her political situation, Colombia has not been troubled with *opera bouffé* revolutions, such as occur sporadically in some Latin-American countries, for at least 20 years.

ANTIOQUIA, the richest, most productive department of the country, is situated in the northwestern part and has a relatively long coast line on the Gulf of Uraba, an arm of the Caribbean. With most of the advantages previously noted—as to natural resources, productiveness, and range of climate—Antioquia is divided, north and south, by four mountain ridges. The department is so rugged, in fact, that its people have a traditional saying to the effect that if the department could be flattened out, it would cover all of Colombia. Wits often quite soberly inform visitors that the natives plant their corn on the hillsides with the aid of shot-guns!

Medellin, the capital city, with an urban population of 120,000 and surrounded by a vast and important agricultural and mining district, is about 100 miles from the nearest point on the Pacific and 150 miles from the Atlantic, as the crow flies. From the nearest Atlantic port, it is 400 miles by air. At an elevation of 5000 feet, it is a city of eternal spring, its average

temperature being 72 degrees, from which it never varies five degrees either way throughout the year. Its citizens simply have no weather to talk about. Americans bored by weather prattle, take note!

Medellin has a country club, modern hotels, and fine shops along with its many relics of ancient Spanish days. For, while it is one of the largest cities of Colombia, it retains much of the color and romance of its historic past.

Up to the present, Medellin has depended principally upon the rivers as trade routes. Most of the products of the surrounding country are brought to the city by pack-animal or ox-cart and, from there, they are shipped to the sea by a slow and uncertain route, by a combination of river-boat, ox-cart or truck, and railroad train

FOR the first 122 miles, the shipment is carried by train to Puerto Berrio. While formerly it was necessary to transfer the shipment near Cisneros to motor trucks or ox-carts for a two-mile trip over a mountain 7000 feet high and reload it on another train at Cisneros, a new tunnel $4\frac{1}{4}$ miles long at this point, to be completed in June, eliminates this "portage." At the river port, Puerto Berrio, it is loaded on boats for the 503-mile trip down the Magdalena River to Barranquilla. There it is again transferred to a train for the last 17 miles to Puerto Colombia where it is loaded on ships bound for world markets.

Shipments inward-bound for Medellin follow this same circuitous, inefficient route in the opposite direction. Mr. John H. Caton, Chief Engineer of the contractor for the new highway, states that: "Experience.... indicates that it frequently takes up to six months for freight to travel from New York to Medellin, three fourths of which time is accounted for after arrival at Puerto Colombia. The freight cost is always high and runs to



"CARRETERA AL MAR"

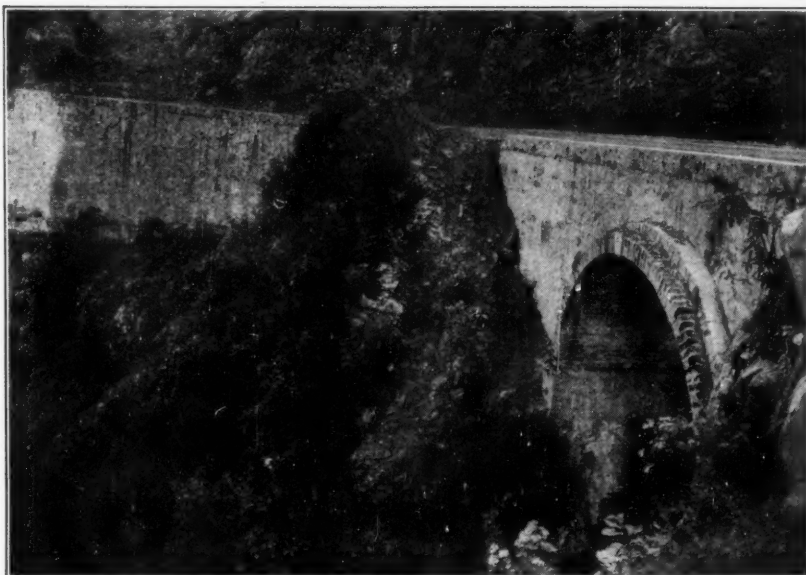
The old route and the new. The dotted line shows the Department of Antioquia

fantastic figures when the river is low." And even if the freight is promptly transferred to the river steamers, he says that "there is a likelihood of loss and damage due to lightly-built, shallow-draft vessels and a dangerous river which is swift and shallow, has a shifting channel, and is full of sandbars and snags. Its vagaries are unknown even to experienced pilots." Furthermore, dry seasons, which render the river unnavigable, often last for months at a time.

THUS Medellin's problem was intolerable. If the city were to progress, something had to be done. The more far-sighted citizens had urged some sort of action for years but it remained for an exceptionally long dry season to give impetus to the movement and cause formulation of a definite plan. Once started, the plan met with instant and unanimous approval. *Carretera al Mar* became the rallying cry for progress—progress for Medellin and the surrounding district.

The Departmental Assembly authorized, in March, 1926, the immediate financing and construction of the first section of the highway. For the construction work, the Antioquians turned to America. The firm of R. W. Hebard and Company, Inc., New York, was recommended and the contract was given to this firm forthwith, without the formality of, or the delay incident to, calling for competitive bids. Construction was begun in September, 1926, and the first section will be completed in August of this year. As soon as possible, the remainder, making a total length of 255 miles, will be authorized.

The engineering and construction staff has been composed chiefly of Colombians and Americans, with the former predominating. Mr. John H. Caton is chief engineer for the contractors and Dr. Eduardo Orozco, of



A SAMPLE OF WORKMANSHIP ON THE NEW ROAD

A half bridge and retaining wall on the *Carretera al Mar* just north of San Cristobal Pass. Numerous works of this nature were necessary along the stretch of road soon to be completed

Medellin, is chief engineer for the Highway-to-the-Sea Commission, the president of which is General Pedro J. Berrio, Governor of Antioquia.

The nature of the country made it necessary to transport motor trucks and working equipment to the scene of operations by pack-mule. Once a sub-grade was constructed, trucks and tractors brought in rock crushers, concrete mixers, compressors, hoists, rollers, et cetera. Much dynamite was used in making cuts through solid rock, but hand labor—pick, shovel, and wheelbarrow—moved practically all the earth and rock. Hand labor is cheap and excellent in Colombia.

BY this method, excavation and movement of over 5,000,000 cubic yards of earth, 70 percent of which was rock, was effected during the first 26 months. Hand labor also constructed retaining walls totaling over 50,000 cubic yards, 44 miles of tractor roads through wild forested country, bridges, pack trails, and drainage ditches.

From Medellin, the completed section of macadamized highway stretches over extremely rugged country in a northerly direction, crosses the Cauca River near the ancient city of Antioquia, passes the cities of Boqueron De Toyo, Canasgordas, and Uramita, and finally terminates at Dabeiba. The obvious reason for beginning the road at Medellin rather than at the coast is that the Medellin area is by far the more thickly populated.

From Dabeiba, the road will run, when finally completed, for 33 miles through rough canyon country. Reaching the valley floor, it will then pass through tropical forested country, uninhabited except by Indians and a few

Negroes. Finally reaching the Gulf of Uraba—an arm of the Gulf of Darien, itself an arm of the Caribbean—it will extend to whatever point is finally selected as the most suitable site for development into a port. Since the gulf is amply deep near the shore at Necocli, this town has been proposed as the future port.

IT is estimated that the daily through freight over the completed *Carretera al Mar* will be in the neighborhood of 700 tons, about equally divided in each direction. Motor trucks will be able to make the trip between Medellin and her new outlet to the sea in 25 hours. Passenger automobiles, however, will make the run in from 10 to 12 hours.

As a scenic route, the new road will be equalled by but few others in the world. Since it will bring Colon, Panama, within two days traveling distance, many are confident that tourists in constantly-increasing numbers will drive along this snakily-winding road, will come to revel in Antioquia's charms, to scent the aroma of myriads of blossoming coffee trees, to find their youth again under the exhilarating influence of a delightful climate.

Limned against a background of slow progress, hard won in the face of insufferable difficulties, the *Carretera al Mar* stands out as a thing apart, evidence of a battle fought and won, a far-flung challenge to the gods of the destinies of nations, a genuflexion to Fortuna. And while Antioquians shout their huzzahs to the skies, Fortuna will return to them profits tenfold and the world, in turn, will share in their prosperity.



PICK, SHOVEL, WHEELBARROW

Excellent and cheap hand labor moved practically all the earth and rock excavated on this section from Medellin to Dabeiba

Our Point

Health and Happiness

AT the recent annual meeting of the National Academy of Sciences, Dr. Ales Hrdlicka gave out some astounding news. He stated that scientists are of superior physique, strength, health, and longevity as compared with the average American. This fact, he said, has been shown by a five-year investigation of physical and physiological characteristics of members of the Academy, numbering about 250 foremost scientists of America.

We have a clipping, attributed to Bertrand Russell, which says: "Men of science, who have less difficulty than others in finding an outlet for their creativeness, are the happiest of intelligent men in the modern world since their creative ability affords full satisfaction to mind and spirit as well as to the instinct of creation. In them a beginning is to be seen of the new way of life which is to be sought; in their happiness we may perhaps find the germ of a future happiness for all mankind."

Coupling the two statements together we find, not the frail-bodied scientist so often caricatured, but a very human person whose happiness and health, as well as his intellectual achievements, are greatly to be envied. Thus must we revise our estimate of the cost—to the scientist himself—of the scientific life, and bestow our sympathy elsewhere. What is sorely needed now is some magical formula for giving vitality and happiness to another group of men whose lives are burned out, often futilely, in our behalf: the confirmed college professors.

What Science Signifies

EXAMPLES, filled with the romance of truth, might be cited by legions to show how this everyday, practical world has profited fabulously in the ordinary monetary sense by the most unpromising discoveries of the scientific research laboratory. One of the most interesting is that of Laue, the Austrian mineralogist. Certainly when Laue proposed one day in 1912 to employ crystals of mineral as a diffraction grating for X rays no one foresaw that before 1929 this mere laboratory curiosity he had hit upon would be employed by the great steel industry to reveal the exact manner in which the molecules of steel rails and structural members of buildings were arranged, or the internal structure

Maritime Law Laxity

PRESS dispatches from London relative to the Board of Trade investigation of the *Vestris* disaster, bring to Americans news of sensational evidence which, if proved, points to a deplorable lack of regulations governing shipping from ports of this country.

The first officer of the *Vauban*, sister ship of the *Vestris*, has given evidence that the owners of the ill-fated vessel made a practice of falsifying their log records concerning the draught of their vessels. He stated that the owners were guilty of persistent overloading and of consistently careless loading. The London testimony further indicates that, in order to lift the *Vestris* to her Plimsoll level, while overloaded, many tons of ballast water were pumped out of her tanks several times during the past few years. The senior surviving officer of the disaster added his opinion that the *Vestris* was a tender ship—had too much top weight.

If the *Vestris* was tender by reason of construction, her cargo should have been stowed accordingly; but if tender by reason of careless loading, overloading, and pumping out of ballast water, then such operation of her was nothing short of criminal. If she was overloaded and that fact led partly to her foundering, then the United States may count herself an accessory to the crime that cost over a hundred lives because our laws did not require inspection against overloading!

What is to be done about it? Obviously, American shipping laws should be revised to cover such conditions. The International Conference for Safety of Life at Sea, which will probably be concluded by the time this is in print, will, no doubt, uncover other irregularities in shipping and indicate the necessity for more stringent regulations for sea safety. But, in America, we should not apathetically await the findings and formulae of the Conference; there are many things that we can remedy at once if only shipping experts will show them up.

of a whole host of metals and alloys, and even for prying open the secret of the elasticity of rubber which man has not yet learned to imitate when he makes synthetic rubber.

What Laue believed he had found was merely a delightfully interesting

method of verifying the pre-existing theory that the molecules in most forms of matter were arranged systematically like the rows, tiers, and layers of oranges in a box. No microscope had ever revealed visually a molecule and none ever can, for they are far more minute than the waves of light. But the tiny waves of X rays, about one ten-thousandth the length of those of light, although otherwise like in nature, happen to be just about the right length to match the dimensions of the molecule.

Thus when these waves or rays are directed at various forms of matter they do not reveal its molecular structure by the ordinary method of permitting us to see through it, but by rebounding from its rows, tiers, and layers of molecules at definite angles. When these angles have been measured—a simple procedure—the molecular structure of this matter has been "felt out" just as a blind man learns the contents of a room or a basket by exploring with his hands.

In actual everyday use the X-ray analysis discovered by Laue is an invaluable aid to industries the world over, and its economic value is incalculable.

The practical significance of a scientist apparently pottering over a bench covered with interesting apparatus was once brought out by the famous Huxley who said, "I weigh my words when I say that if the nation could purchase a potential Watt, or Davy, or Faraday, at the cost of a hundred thousand pounds down, he would be dirt cheap at the money. It is a mere commonplace and everyday piece of knowledge that what these men did has produced untold millions of wealth in the narrowest economical sense of the word."

Huxley's attempt to awaken a nation to the desirability of investing in scientists is far more apposite today than it was in the last century. A hundred thousand pounds—500,000 dollars—was much too cheap a price for any one of this trio of geniuses. Without risk of exaggeration we may value them at six ciphers higher. Watt made a mighty extension of man's power when he took the clumsy steam engines of his day and made them over into the smoothly running, flexible machinery of ours, so that they brought about the whole great "mechanical revolution" that all but freed man from physical labor and multi-

of View

plied by hundreds the wealth of nations; Davy's safety lamp for miners might alone be said to have contributed untold advantage to industry, for it enabled the miners to get out of the earth the vastly increased tonnage of coal required to run Watt's engines; while Faraday actually discovered the working principle of the dynamo.

Late in 1895 the German physicist Röntgen discovered the X rays. This fact soon became rumored about in America and we can imagine that there must have been much the same kind of eager suspense among technical and scientific men during the weeks before authentic accounts were published, that took place last winter when the forthcoming publication of Einstein's newest theory was announced.

The first scientific journal to publish in America an account of this discovery by Röntgen of the X rays commented, "When the details reach us the process will probably prove to be of scientific value rather than of practical interest." Whoever ventured to make that prediction widely missed his guess. Most of us know that the X rays have proved to be somewhat "practical" at times! (The journal which made this prediction was none other than the one the reader now holds in his hands!)

Today scientists and editors of scientific journals are more cautious about such pronouncements than they were in 1896. They have learned that few discoveries, no matter how remotely they seem to pertain to anything practical, fail to find invaluable practical applications. No one has been heard to say that Einstein's recent effort to bring gravitation under the same laws as electricity will never be turned to practical account. The lesson has soaked in; science is a grab-bag and some of the things the worker gets hold of turn out to be immensely larger than they felt.

One might go on indefinitely recalling similar instances which point out the economic significance of science to the world. Everybody knows the end-products of scientific investigation because everybody uses them. But few know, because comparatively few take pains to inform themselves by careful reading, the stages by which these end-products have shaped up. Many see only what is on top. They accept, for example, the blessings of our knowledge of germs and germicides, without knowing how Pasteur discovered germs

as the chief source of disease; they use a large variety of chemical compounds without knowing the meaning of chemistry; they admire skyscrapers, great bridges, and other complicated structures without knowing how Galileo laid the firm foundation of the laws of forces without which these struc-

Food for Thought

HOW many of us have gone into a drug store for medicines and been discouraged in our quest because of the array of coffee urns, dishes, and foods of various kinds! Our rage is voluble. How could a *restaurant* fill a doctor's prescription? Drug stores are going to the dogs, we tell the clerk who finally condescends to take care of our mere prescription.

Despite our misgivings, however, there may be scientific justification for the drug-store lunch counter. Dr. W. L. Scoville, who recently received the Remington Medal of the American Pharmaceutical Association, says so. Modern scientists have found that the distinction between foods and drugs is less pronounced than formerly and, in fact, physicians often ignore drugs entirely in certain cases and prescribe food diets, sunshine, and fresh air. Food has attained a high rank in the treatment and warding off of disease because of its vitamin and mineral content—about which little was known until recent years—and it is appropriate, therefore, for it to be closely associated with the sale of drugs.

As for those drug stores that prostitute their space to the wares of department stores, words fail us. Too frequently they have failed to supply our drug needs through lack of supply, yet as we made our way out of the store, we have been harassed by the importunities of myriads of clerks selling toys, candy, books, electric irons, and heaven knows what!

tures could not be safely erected. They miss an infinitude of things which others see, because they do not take the trouble to read—perhaps more frequently because they do not know what books to read.

Relatively speaking, even today only a few carry on the advance of science. There are millions, otherwise intelligent people, whose outlook on the world is still essentially that of the Middle Ages. Alchemy still exists in

active form; its votaries publish a special journal. "Hexing" is still rampant in one of the most prosperous regions of our nation. Plenty of people consider it just as well not to raise an umbrella in the house or walk under a ladder. A large number confuse science with pseudo-science and are easy game for all kinds of quackery purporting to cure bodily ills. Astrology, as mentioned before, is more popular than astronomy. The people of a sovereign state attempt to settle by referendum vote the question whether man is a product of organic evolution; for them to attempt a popular verdict on the Einstein Theory would be no less absurd. The world has a long way to go before it can be said to have come of age.

Withal, we progress.

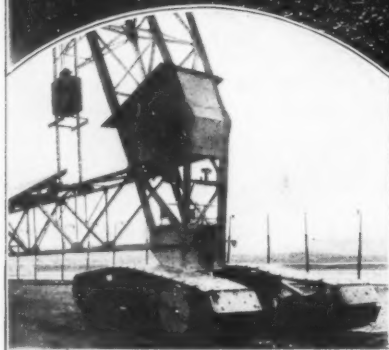
Reforestation

FROM time to time we have pointed out the necessity for a practicable program for the conservation of our timber resources, and many other publications have done likewise. These appeals have not been unfruitful but, by their number and frequency perhaps, have stimulated a general interest in a vital question that has been brought to the fore only in the last few years. Many lumber companies are cutting selectively and some of them even replant land after they have cut it over; and various states have adopted plans for reforestation that will assure in future years a plentiful supply of yearly-maturing timber.

Besides their great lumber value, trees hold winter snows on watersheds and prevent the sudden thawing which so often results in spring floods; they minimize erosion of soil by holding rain water in the undergrowth and the mulch of leaves; and, in summer, they may prevent the drying up of streams dependent upon underground seepage. Spring floods, soil erosion, and dry streams are in evidence in many sections of the country but usually little attention is given to their cause.

Every state in the union could, to its own profit, emulate the constructive conservatism of New York State. Already it has planted or sold for planting, around 20,000,000 trees. Seedling trees and young transplants are being sold by this state at the nominal rate of two dollars per thousand for seedlings and four dollars per thousand transplants.

From the Scrap-book of Science



▲ GREATEST MOBILE CRANE

This huge and powerful crane, a German product, is being used by a firm in Leipzig to level a large hill and fill in the adjoining swamp. The two extremely long arms lift the soil from the hill, rotate to the swamp, and dump the material. Seemingly dwarfish tractors carry the giant machine about while it is on a job. One of these, with its two broad articulated treads, is shown in the insert at the left. It is taken apart for transportation

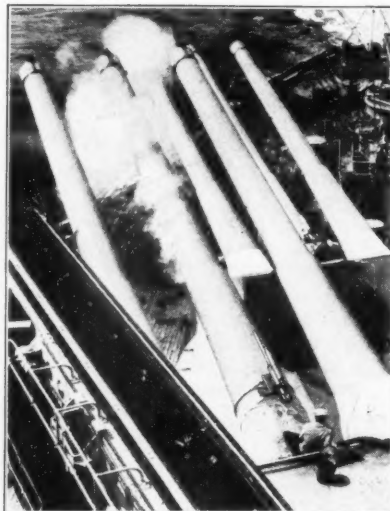


THE ANGELIC BOBBY

Singapore, in the Straits Settlements, is a busy city where the temperature hovers around and over 90 degrees, shade or no shade. To save traffic policemen undue exertion, the city has given them rattan "wing" signals

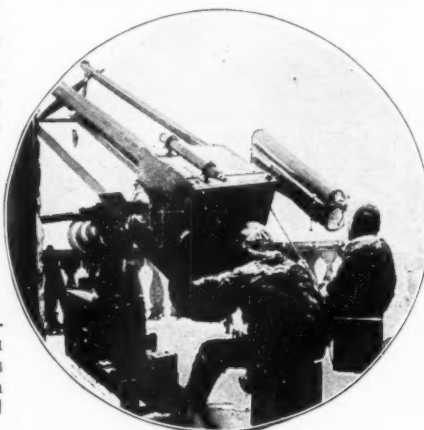
JUST PLAIN DIPPY

Dips and rises ranging in depth from 5 to 10 feet give the motorist a thrill on this 2243-foot stretch of wooden road recently built at Los Angeles. An admission fee is charged for cars



MASSSED POWER

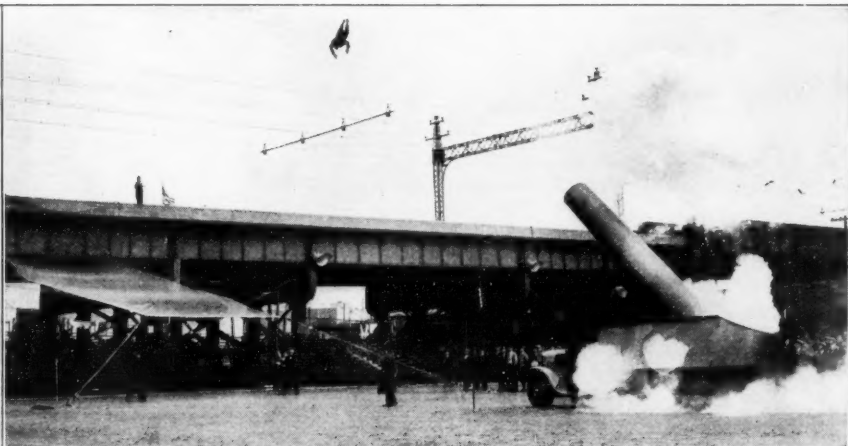
A striking view of six of the 12 14-inch guns of the *U.S.S. California*, the photograph having been taken looking downward past one turret toward the guns of a lower one. In the foreground is a sailor who has just fired off a one-pounder. Instead of firing the big guns—every shot from which costs hundreds of dollars—the sailors often practice with the smaller guns. At the lower left is shown part of the catapult from which airplanes are launched



COLD ASTRONOMY ➤

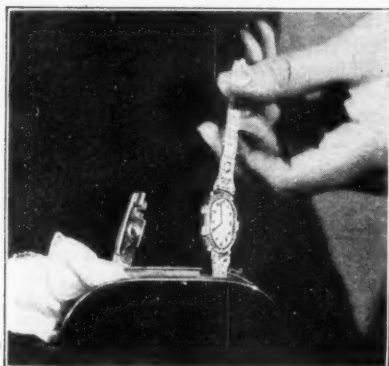
Scientists who study the heavenly bodies do not always have a comfortable observatory where they may work. In the case of those shown here, arctic temperatures, snow, and the necessity for outside observations render their work difficult. This photograph was taken at the astronomical observatory on the Jungfrau ridge in Switzerland. The observatory is situated in an exposed position at an elevation of over 11,300 feet above sea level





THE CIRCUS HAS A NEW HIGH DIVER—FROM A GUN

The old time high diver who used to thrill us by his spectacular leaps from a high tower into a water tank, has been outdone by Hugo Zacchini, now traveling with a famous American circus, who is shot from a gun daily as a feature of the program. At the left is shown Hugo, the daredevil; and at the right, Hugo, the projectile. The secret behind this feat is believed to be a spring which throws Hugo at the same time a small charge of powder is fired. He lands in the net shown at left



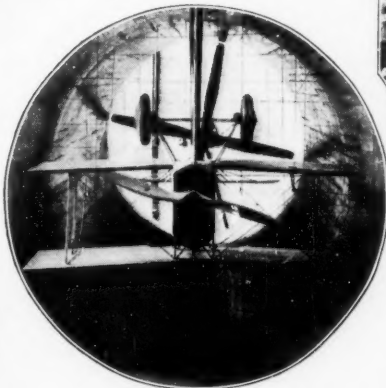
SURF SAFETY FOR VALUABLES

Seen on southern beaches recently, this water-tight purse will doubtless make its appearance on northern beaches soon. It is either woven into the bathing suit or worn attached to the belt. It provides a safe and, it is said, a dry receptacle for valuables, money, and cigarettes and matches



THE "PENSACOLA" GOES DOWN THE WAYS ➤

The *U.S.S. Pensacola*, second of the so-called Treaty Cruisers and a sister ship of the *U.S.S. Salt Lake City* which was launched recently (See SCIENTIFIC AMERICAN, May, 1929) was launched at the Brooklyn Navy Yard, New York, on April 25. She is the first ship to be constructed at the Brooklyn Navy Yard since 1919. She will have the same armament as the *Salt Lake City*, is 585 feet long over all, and has a beam of 65 feet 6 inches. She will have a crew of 530

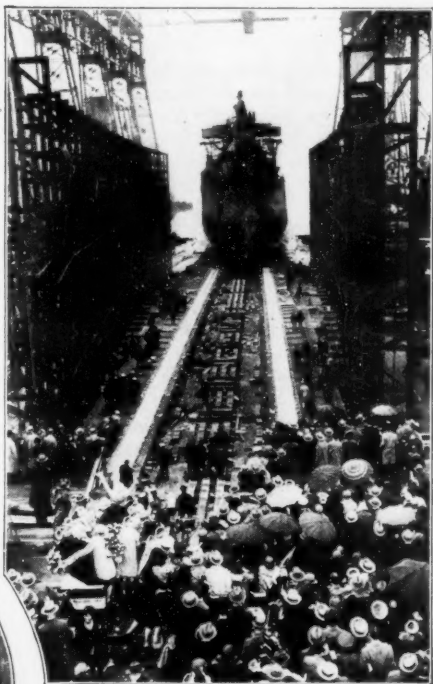


HOW THEY'RE TESTED

Unique view of a scale-model airplane being flight tested in the wind tunnel at the Massachusetts Institute of Technology. In such tests the models are always suspended upside down and their flight characteristics investigated

◀ A LITTLE LEG BONE

Part of a leg bone of one of the large dinosaurs of the Jurassic Age, recently found in the McElmo shale formations near Grand Junction, Colorado, by Mr. E. B. Faber. This bone, broken by exposure, now measures 22 inches across larger end. There are many dinosaur remains in the McElmo formation



NO WATER-SOAKED MAIL

Mr. L. A. Stelhouse of Baltimore, Maryland, pouring a glass of water into a mail box which he has invented and recently demonstrated to Post Office officials. Water which enters the mail chute at the top runs out at an opening in the rear without dampening the contents of the box



THE LARGER OF THE BRONZE AGE BURIAL MOUNDS

Figure 1: The mound does not show very distinctly, owing to the vegetation which tends to camouflage it, but when seen at the site such a round burial mound is a clean cut feature

The Invaders of England

An Account of the Excavation of Early British Burial Places

By J. REID MOIR

Fellow of the Royal Anthropological Institution, Member of l'Institute International d'Anthropologie, Past President of the Prehistoric Society of East Anglia

AFTER the departure of the Romans from England, when the greatest empire the world had ever known was declining to its fall, a series of raids and invasions by people living across the North Sea began.

While the Roman power was in force in Britain these attacks had been guarded against and repulsed, but its withdrawal inaugurated a period of strife and bloodshed which lasted for a considerable time.

It was in the east of England that the worst of these struggles took place. All up and down the coast, and on the broad estuaries leading inland, are to be found abundant traces of the invaders who at this epoch entered the country.

ALTHOUGH there are in existence no actual written records of what then took place, the evidence of sanguinary fighting, in the form of dismembered human skeletons, is often unearthed, and the necessity for defending their hearths and homes must have come to the East Anglians of these days with a frequent and deadly insistence. That this was the case is shown by the inclusion in the litany read in the East Anglian Churches of this period of the supplication, "From the fury of the Northman, O Lord, deliver us."

Those who are familiar with the low-

lying coast of Essex, Suffolk, and Norfolk and of how with the oncoming of night the sea-fog reduces visibility to a minimum, can form some idea of the state of tension which must have been present when it was known that ruthless invaders were waiting for just such an opportunity to carry out a raid. Running up the eastern coast line is a sand-belt some 12 miles in width,

which gives rise to some of the most beautiful scenery in this part of England. The country is undulating, intersected by wide estuaries and river valleys, while pine trees, heather, and gorse flourish abundantly, and give shelter to innumerable birds of the English heathland species.

At certain places on the high ground between the river valleys the sandy country is flat, and very often on these places are to be seen a number of round burial mounds of the people who, many centuries ago, crossed the North Sea in search of new and unexplored country. About three miles to the east of the town of Ipswich there exists a wide flat plateau about 150 feet above sea level, where a number of these mounds are present, and recently I carried out on behalf of the Ipswich and District Natural History Society, an investigation of two of the burial places. (See Figure 1.)

IN England the round barrows, as they are called, are generally of Bronze Age date, while the long examples are referable to Neolithic days. Strange to say, although numerous and very fine flint implements of the latter epoch have been found in East Anglia, not a single example of a burial mound of Neolithic times has yet been discovered in this area. But those of Bronze Age and later date are numerous and it was in two of these that excavations were undertaken. The mounds, which were of unequal size, lay close to each other and the larger was first attacked.

The investigation showed clearly not only the age of the barrow but also how it had been constructed. An area had first been cleared and dug to a depth slightly below that of the surrounding ground level and it was in this ex-



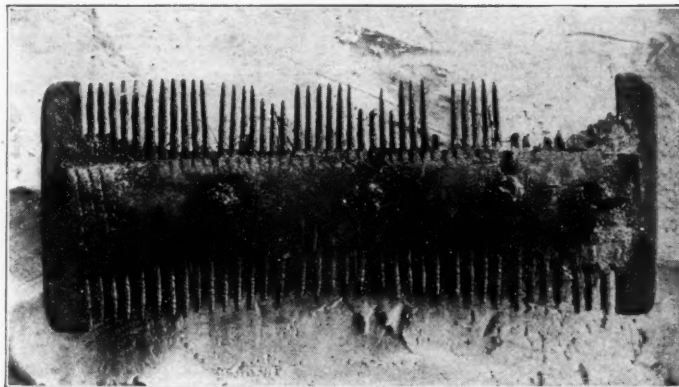
THE SMALLER OF THE TWO MOUNDS WHICH WERE OPENED

Figure 2: This was of Anglo-Saxon age. It supplied the artifacts shown on opposite page. Mr. Moir, the author, is seated on the edge of the opening, overseeing the laborer's work



ANGLO-SAXON BRONZE BOWL

Figure 3: Although made of bronze this should not be confused with Bronze Age date—we still use bronze



BONE COMB OF ANGLO-SAXON DATE

Figure 4: Natural size. Found within the bronze bowl shown at the left. Historians have comparatively little knowledge of the Anglo-Saxon period

cavated portion that a burial of Bronze Age times had taken place. Although the sandy nature of the soil had precluded the preservation of the human bones, we found numerous and unmistakable fragments of Bronze Age pottery scattered about, and with them a great number of small but very well-flaked flint scrapers. The quantity of these discovered, and their distribution, points clearly to their use as a funerary offering, showing that even in Bronze Age days flint implements had already begun to have a magic significance. After the scattering of the pottery fragments, and the flints, a low rounded mound of earth was erected over the burial and the ceremony apparently ended by the lighting of a large fire on top of the barrow.

THE smaller mound investigated proved to be of even greater interest (Figure 2). It was evidently the custom of the Anglo-Saxons to erect tumuli over their dead, and frequently to do so close to the burial mounds of much earlier times. This was the case in the graves examined to the east of Ipswich, as the smaller tumulus contained relics of pagan Saxons. In the center of the mound was discovered a beautiful vessel of beaten bronze (Figure 3), of an extreme thinness, which had evidently been used as a receptacle for the cremated remains of the dead. Unfortunately, a rabbit had made its burrow actually through this vessel, but in spite of this, many interesting relics were recovered.

The human bones represented more than one individual, among them a very young child, and with them were two bone combs with iron rivets (Figure 4), chessmen made of clay, remains of ivory bracelets, and part of an ornamented disk of bone (Figure 5). From the nature of the majority of these objects it is possible to conclude that this was a grave of female Anglo-Saxons buried with some of their personal ornaments. When the remains had been placed in the bronze vessel, a piece of canvas-like material was placed

over the mouth and tied round the rim with something corresponding to modern string, for pieces of these materials were actually present when the bronze bowl was found, and can be seen still attached to it in the Ipswich Museum.

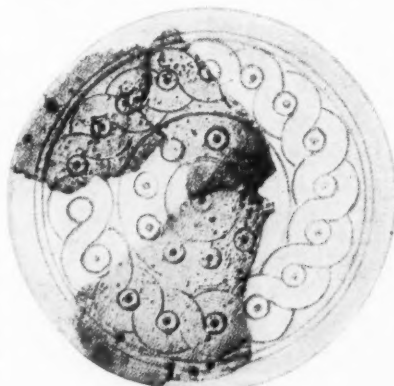
The earliest graves of the people who invaded East Anglia in Saxon times are found upon the banks of the Rhine, and the progress of these people westward can be traced by the funerary and other relics which they left behind them. A very extensive burial ground situated upon the south bank of the River Gipping in Suffolk, was discovered at Ipswich some years ago by Miss Nina Layard, when a remarkable series of weapons and ornaments came

ceased, and while the male skeletons were accompanied by spear heads, bosses of shields and knives, those belonging to females were associated with jewelry, consisting of brooches, necklaces of beads and silver pendants. With the women were also buried their household utensils, such as iron pot-hooks, keys, and spindle whorls together with toilet requisites, including combs and similar objects.

THE Ipswich cemetery of pagan Saxon times is probably to be referred to about the Sixth Century, and its discovery, together with that of the burials on Markesham Heath, indicate that these people had settled down permanently and were living an ordered life in East Anglia. These and other discoveries of a like nature are helping us to form some idea of the condition of affairs existing in England after the departure of the Romans. But, although the Saxons had succeeded in largely subjugating East Anglia, they were there as conquerors with all the responsibilities such a position imposes. They had to maintain themselves in what was without much question a definitely hostile country and although they were able to do this, and were possessed of a civilization by no means to be despised, yet the Saxons must have presented a violent contrast to the Romans under whom, for over 400 years, England had been dominated.

The remains left by the Romans—gigantic walls, roads, and buildings of various kinds—testify to the greatness of these people and to the excellence of their methods of building. In the case of the Saxons, it is almost solely by their burial grounds and mounds that we know anything tangible about them.

Today, where the pagan Saxons had their burial ground on Markesham Heath in Suffolk, a large aerodrome exists, and the most modern flying machines rush through the air above the peaceful resting places of a long forgotten people. To visit this East Anglian scene is to witness the past and the present in startling contrast.



DISK OF BONE

Figure 5: Only the shaded parts were found. The rest of the disk is a reconstruction

to light. No less than 159 graves were found, and from them Miss Layard recovered quantities of beautiful beads, iron spear heads, knives, shield bosses, brooches of rare Anglian type, bronze buckles, double toothed combs, earthenware pots, glass drinking cups, and other relics.

The bodies had been buried in the extended position, and the bones unearthed point to a well made and robust race of people. The weapons were laid close to the side of the de-

The Marvelous Machinery of Muscle

By Learning to Understand the Physics and Chemistry of Our Muscles We May Obtain Increased Control Over Them

By DONALD A. LAIRD, Ph.D., Sci.D.

Director, Colgate Psychological Laboratory
Chief of Staff, Personal Analysis Bureau (Chicago)

COMING back from an evening engagement 80 miles from home a short time ago, my driver had to pick his way along roads covered with sheets of ice. Chains on all four wheels of the car helped, of course, but they could not offset the numberless hills we had to climb and the high crown on some roads constructed years ago. It was a continual struggle with the steering wheel for five tensed hours. I am still wondering how we kept out of the ditch time and time again. We passed fully two dozen cars that had landed in the ditch, and were unable to get out. Since no garage would hazard its wrecking cars on the slippery roads, the ditched cars had to remain where they were until a thaw or snow relieved the perilous condition of the roads. We came through without a scratch, although it was so late when we finally came home that the family was somewhat apprehensive.

THERE are two predominant reasons why we came through safely, when more cautious persons might have stopped at the first inn for the night. First and foremost in these reasons is the fact that Lester is a skilled and very careful driver. Second, and perhaps equally important, is the fact that I had just finished outlining scientific information preparatory to writing this article and now applied it to Lester's muscles while he was steering the car. His muscles were still relatively fresh and retained an accurate control of the wheel after other drivers' were worn out and could not maintain their usually skilled control in steering.

Rear-seat drivers as a rule are more of a pest than the person who has already heard all the humorous stories you want to tell him. This is the first rear-seat driving I have done, and it was so successful that I almost feel like starting a course in the Psychology of Rear-Seat Driving. This course would not teach one to tell the driver how fast to drive, but how to help the driver save his muscles and still maintain accurate control over them after five hours of extremely taxing work.

The rear-seat guidance on this night consisted of providing the driver with candy; stopping every 20 minutes for

a five minute rest, during which four minutes were spent stretched out in the rear seat and breathing deeply after one minute of looking at the chains; using positive suggestions by saying to Lester from time to time, "We're keeping in the road splendidly," rather than giving a negative suggestion by saying "It's a wonder

slip toward the ditch. (Incidentally this also lessens the skidding hazard, although it was included primarily to save fatigue and thus retain control).

This is but one typical emergency when a knowledge of the inner workings of the machinery of muscle yielded better control over the situation. There are almost innumerable practical situations in which the answers to the following questions will prove invaluable:

- Are there some foods which give a better control of muscle?
- Is energy saved by moving quickly?
- Why will heavy work with one arm tire out the entire body?
- Does climbing up stairs require more energy than walking on the level?
- Is it nerves or muscles that give strength and power?
- How many horsepower can the average man exert?
- Will deep breathing help one to recover from fatigue?
- Is walking rapidly better for the muscles than walking slowly?
- Does massaging help the inner machinery in muscles?
- Are muscles as efficient machines as automobiles?

ALL body machinery is predominately chemical and physical. Perhaps some day we will understand it and guide it better in electrical terms, since experimentation in general indicates that the chemical and physical often resolve themselves into more basic electrical phenomena. But there is a vast vista of chemical and physical knowledge available about these essential muscle machines which is sufficient in itself to permit gaining much practical understanding about our muscles. A practical mastery of muscle, however, requires more than complete chemical knowledge.

The foremost authority on muscle, Dr. A. V. Hill,* the distinguished London scientist, has recently pointed this out. "With this machine intelligent human beings have to work," he says, "aided by moral qualities of courage and resolution. Some will

*See A. V. Hill, "The Scientific Study of Athletics," Sci. Am., April, 1926; also "Are Athletes Machines?" Sci. Am., August, 1927.—The Editor.



MEASURING ENERGY

Top: Air exhaled from the lungs is collected through a short piping in a large rubber bag. The mask on the typist's nose and mouth has two rubber flutter-valves, one to allow room air to be breathed in, and the other to open on exhalation and allow expired air to pass into the bag through the piping. Below: After being thoroughly mixed up, the air collected in the bag is passed through a meter to determine how much is exhaled per minute, and a sample of the exhaled air is then analyzed by this apparatus to determine the percentage of carbon dioxide and oxygen it contains. From this the energy may be calculated

we didn't go into the ditch that time"; and teaching the driver to move his muscles slowly when turning the wheel rather than quickly and forcibly when the car started to

work their machinery better than others. Some will fail by lack of the necessary mental qualities, by lack of the necessary skill. Some will neglect to keep their machinery in order. Others will fail for lack of resolution." And Dr. Hill knows what he is talking about in more than a dry scientific way—he is no mean athlete himself.

Knowing the dynamics of muscle chemistry will not provide the courage and resolution and perseverance. But it will make the courage more fruitful. It should give courage, for example, to learn that a trained runner develops around seven horsepower of mechanical energy from the chemical transformations in his active muscles!

IT should give still more encouragement to discover that one of the most efficient engines in the world is that of our muscles. A steam engine with a modern condenser has an efficiency of about 15 percent—if it is a good engine. This means that for every 100 calories of fuel energy consumed under the boilers, the engine returns only about 15 calories of productive mechanical energy. Gasoline engines have an efficiency of from 20 to 25 percent. Expensive Diesel engines have an efficiency of 20 to 35 percent. The trained athlete may have a muscular efficiency of more than 40 percent!

The fuel burned by muscles is in the form of a sugar known as glycogen. Each contraction or twitch of a muscle uses up some of this glycogen. The fire draft which supplies oxygen to the muscles so they can burn the glycogen as it is needed is the red blood cells. These take up oxygen from the air in the lungs and carry it throughout the body, and a working muscle which needs oxygen takes it up from these

red cells automatically—like an automatic thermostat which opens and closes the furnace drafts at home.

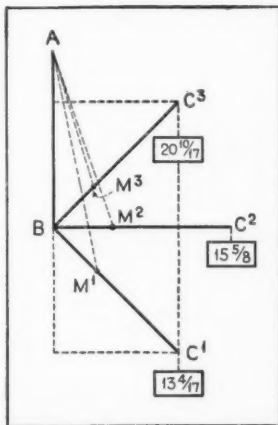
A hard working muscle will require more oxygen than can be brought to it by the red cells. But unlike the basement furnace the muscle does not stop work at once; it keeps on working in a fatigued condition and runs up what is called an oxygen debt.

It can not keep this up long, but it is done every day in running to catch a train or to answer the telephone, in doing the week's washing, and in some modern dances. Whenever one's working rate changes it takes some two minutes for the rate of oxygen intake to adjust itself to the new demands. The oxygen follows, does not cause.

Two apparent poisons are given off when muscle engines work. The glycogen becomes split into lactic acid and carbon dioxide. Lactic acid is produced every time a muscle works. The faster it works, the more acid is formed. If

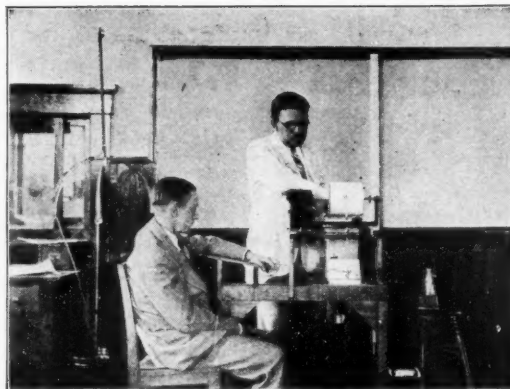
ARM STRENGTH

Chart showing relative strength of the arm in different positions. AB represents the upper arm, BC the lower arm. AM diagrams the muscle. Assuming the muscle to be exerting a force of 50 pounds pull with the arm in position ABC^1 only 13 $\frac{4}{17}$ pounds can be lifted, while at position ABC^2 the same force of 50 pounds pull will lift 15 $\frac{5}{8}$ pounds, and in position ABC^3 20 $\frac{10}{17}$ pounds. This explains why the waiter raises his tray to a high carrying angle analogous to position C^3 .



the muscle is working especially hard, the acid is produced more rapidly than it can be removed. It accumulates. A hard working man is more acid than the resting man!

Only one arm may be used, but if it is exercised strenuously enough so much lactic acid will be accumulated that it will be carried by the blood to remote parts of the body. If it accumulated solely in the arm muscle it would quickly stop activity. But when diffused to other muscles in the body it may make them tired. So exercise in one part of the body may make the entire body tired! There is a bright side to this picture, however. When the lactic acid is carried to lodge in other muscles there is more oxygen available to counteract it than if it remained in the arm. We actually may recover from a tired arm in our legs! This is something the steam engine cannot do.



WORK RECORDER OR ERGOGRAPH

This apparatus measures muscle fatigue. The subject is flexing his middle finger against a spring until the muscles are exhausted by the many repeated efforts.

Another miracle which makes muscle more efficient than a steam engine, even with condensers for bringing the exhaust steam back into the boilers, is that the oxygen acts upon the lactic acid to restore much of it to glycogen. As much as three fourths of the glycogen may be restored.

Muscles in different parts of the body vary in their ability to re-form glycogen, and in their ability to withstand amounts of lactic acid before they stop working; some of them do more work, although consuming less glycogen. Quickly moving muscles require more energy from the body than do slowly moving muscles. The red muscles are more efficient than the white or pale muscles.

Muscles of warm blooded animals are capable of twice the work of those of cold blooded animals. In-

sect muscles are even more powerful in proportion to their size—an apparent exception to the rule that slow movements are more efficient than quick movements. How great is this difference between warm and cold blooded animals can be seen from a comparison of the strength per unit of size of frog and human muscle. Per unit of mass the human muscle is from two to ten times more powerful.

REGARDLESS of the relative power of different kinds of muscles, it is now obvious how deep breathing increases the oxygen available for combating lactic acid. The increase in available oxygen is slight in deep breathing, but tremendously helpful. If our atmosphere were to change so that there were more than the 20 percent of oxygen of our present atmosphere it is very probable that the



MUSCLE MECHANICS

There is less fatigue and greater strength when the weight is held palm upward—about 10 pounds more can thus be held



WHAT IS THE BEST RATE FOR TAPPING, TO PREVENT FATIGUE?

The smoked cylinder makes an electrically conveyed record. By a study of such records it can be ascertained that there is an optimum rate for a repeated effort of this type

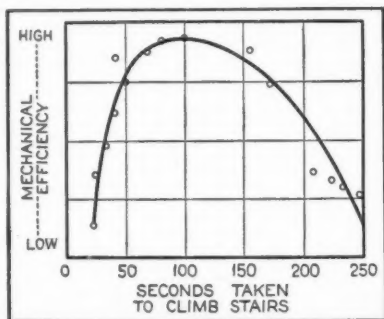
resistance of muscles to lactic acid fatigue would be increased. This is proved by actual experiments in artificial atmospheres containing as much as 50 percent oxygen.

How well the blood can take up oxygen from the air breathed into the lungs is also important in determining how well they can fight lactic fatigue. Trained athletes carry more oxygen in their blood than ordinary persons—nature can be helped by training. In some diseases, such as anemia, the oxygen transporting power of the blood is lowered, making the patient tire quickly.

THE oxygen debt may take 30 minutes to be completely paid off after moderate exercise. After running 100 yards at top speed it may take an hour of rest for the oxygen debt to be paid. In the narrative at the beginning of the article the driver's short rest periods with complete relaxation—except for deep breathing—helped keep his oxygen debt low. His lactic fatigue had been partially offset, while other drivers were steadily acquiring a greater and greater lactic acid accumulation and oxygen debt. Even the trained runner has about four grams of lactic acid liberated by his muscles every second. Little wonder a race is exhausting.

Fatigue recovery is further helped by having an unrestricted circulation. No laboratory experiments have been conducted upon the effect of wearing a tight belt or corset upon fatigue recovery. Dr. Lindhard, however, has found that in exercises where the body is supported with the arms bent on gymnasium rings, the oxygen debt was increased by the blood supply to the active muscles in the arm being cut down by the pressure on the rings. Running is a most efficient use of muscles since the entire circulation is stimulated and the flow of oxygen

carrying blood to all the muscles is facilitated. Working in a position which restricts the flow of blood acts in a way similar to the arm-pressing gymnasium rings. Sleeping in cramped positions—as in an attempt to keep



HOW FAST UPSTAIRS?

Actual records showing how in stair climbing if one goes too fast or too slow there is a lessened efficiency. The points of "high efficiency" are in actuality points of least oxygen consumption, mechanical efficiency being the inverse of the latter

warm—comes under the same category. The heart is doing a great deal in pumping 17 gallons of blood every minute; posture or dress may tend to force an increase in this phenomenal record which it is making every minute of our lives.

Common drugs, such as caffeine, have unusual effects upon muscles. After a muscle is stimulated for a few seconds in a dilute solution of caffeine it has a typical contracture, just as if the muscle were given a shock every few seconds. It acts to release slowly, but continuously, the series of chemical events which normally take place rapidly. The muscle may be given a brief stimulation by caffeine and the contractures appear several hours later.

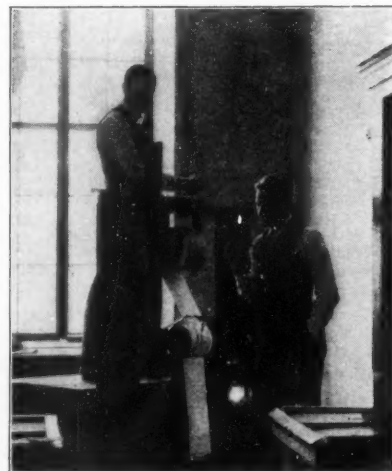
Various methods of using muscles yield varying efficiencies. In climbing stairs, for instance, the most efficient

rate is one step about every second; every 1.2 seconds to be exact. This can be gaged individually without the help of a stop watch by counting "One—Mississippi; two—Mississippi; three—Mississippi; and so on." This comes close to indicating a second on each count. Stair climbing is actually about 15 times as energy consuming as covering the same distance on the level. Even stopping takes energy; the track athlete expends energy in stopping equivalent to running about another five yards at top speed.

THE fuel used up by the muscle, glycogen, is a carbohydrate. For a long time scientists were in controversy regarding whether fats could be used as muscle foods. It is now apparent that the body may transform fats into carbohydrate. But experiments by Krogh and Lindhard have demonstrated that muscular efficiency is highest on a diet that is predominately carbohydrate. This has been confirmed as the primary fuel of muscle by Dr. Furusawa, the Japanese investigator.

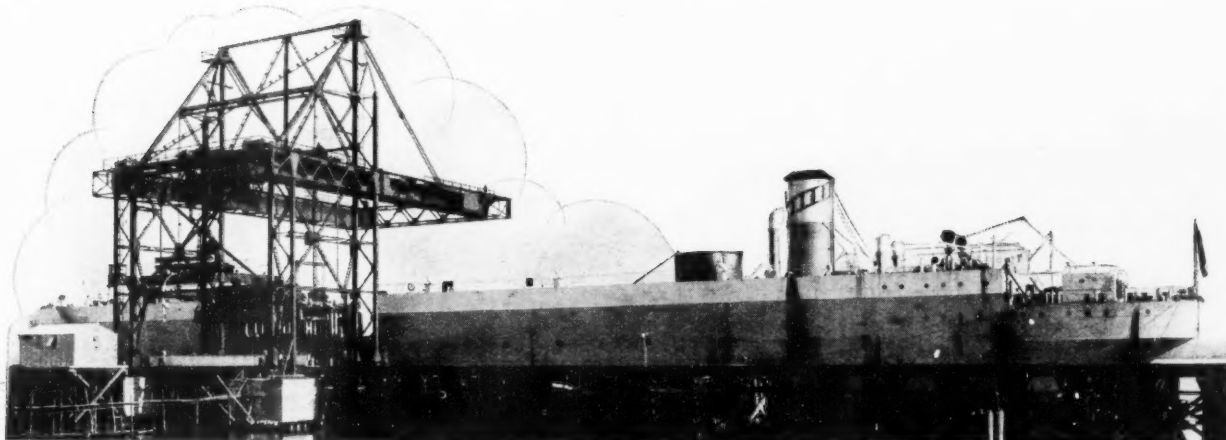
Foods which predominate in carbohydrate content are beans, barley, bread of all kinds (especially toasted), corn meal, crackers, dates, Farina, grape butter, hominy, honey, macaroni, molasses (cane), oatmeal, prunes, raisins, rice, Shredded Wheat, sugar (100 percent carbohydrate), wheat, and zweibach.

Foods may enter into muscular efficiency in another way. The oxygen-carrying power of the blood seems to be dependent upon the presence of iron. Foods especially rich in iron are almonds, beans, dates, eggs (especially the yolks), figs (dried), hazelnuts, lentils, meat (lean beef), oatmeal, prunes, raisins, rye, spinach, and whole wheat.



GIANT ERGOGRAPH

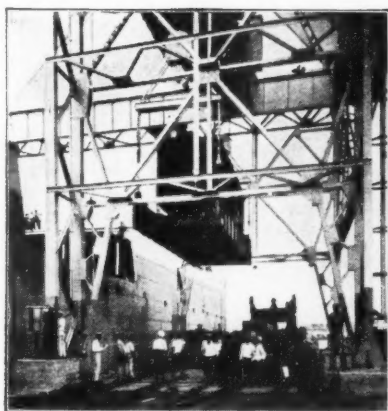
This is another work recorder, designed by David Campbell (right) which is used at the Colgate laboratory to determine the best ways of using the muscles of the arm and trunk. Note recording pen or stylus



A TRAIN GOES DOWN TO THE SEA IN A SHIP

Side view of the *Seatrain*, the car-ferry which plies between New Orleans and Havana, being loaded by means of the giant crane at a terminal port. Each car is raised on a platform, then lowered through the hatchway and rolled off at the proper level

A Ship That Carries Trains



A CAR IS HOISTED

Close-up of the dock crane showing a car being elevated to the ferry deck

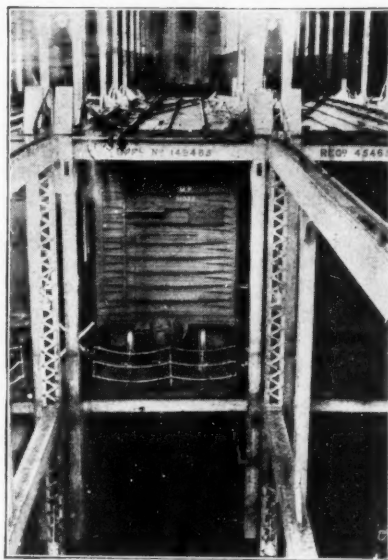
PRODUCTS shipped by water by the usual method of transfer from train to steamer, are subject to much loss and delay. Pilferage is a common occurrence on docks; breakage and loss due to sifting from bags and boxes cannot be prevented; and the necessity for frequent transfers causes considerable delay which may be particularly costly in the case of perishable freight. In addition, there is the possibility that rain may ruin cargo while it is on the docks ready for loading. This applies not only to perishable freight but also to heavy machinery from which crates have been omitted due to the freight cost of this added weight.

A short time ago a car-ferry service, employing a new type of car-carrying vessel, was inaugurated between New Orleans and Havana. The new vessel, appropriately named the *Seatrain*, was built in England under various American and foreign patents. It has a capacity of 95 freight cars. Weekly

sailings will be maintained between New Orleans and Havana, the *Seatrain* making connections with railroads in each of these two cities. The voyage between the two ports requires in the neighborhood of 50 hours and, although we have received no recent report of the time necessary to discharge a cargo of cars and load a fresh complement, it was estimated beforehand that this would take about 10 hours.

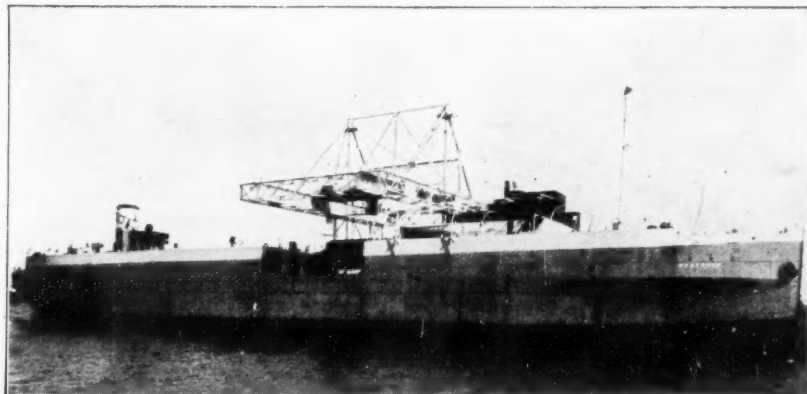
The chief novelty in the design of the *Seatrain* as compared with previous railway ferry-boats, is that the cars are carried throughout the holds between the decks and superstructures instead of on only one deck. At the terminal ports, special shore appliances in the form of huge cranes load and discharge the cars.

The length of the *Seatrain* is 427 feet 6 inches, and its maximum dead-weight tonnage is 10,500. The midship hatchway is 45 feet 8 inches long and is divided transversely at each of the three car levels into four sections.



STANDING ROOM ONLY

Interior of the *Seatrain*. Note car anchorage rails beside the standard car rails



AS THE CAR FERRY APPEARS FROM THE WATER

As will be seen, the loading crane extends over the full width of the ship. The vessel is trim and its deck is relatively clear. Note that the bridge is forward and the funnel aft



All photographs by the author

SULFUR COLORED POLYPORE

THERE is no doubt that large quantities of delicious food of the mushroom variety go to waste in our fields and woodlands every year. If we walk through the woods almost any day from July until the end of November, especially after frequent rains, we probably see and pass by a number of different kinds of edible fungi that are neglected even by those who recognize them or could learn to know them with very little trouble.

THE sulfur-colored polypore is one of these. I have seen at least a hundred pounds of it at one time on an old oak log, all fresh and inviting and ready for the oven. Few of our fungi are better when broiled or baked than this splendid species, which may be readily recognized by its size and brilliant coloring. The yellow or orange clusters appear on dead spots in trunks of oak, ash, and various other trees, which are seriously attacked by it.

The flesh is yellow, cheesy, tender in young specimens, and well flavored. On the under side are minute sulfur-colored tubes, which need not be removed before cooking. The frondose polypore, usually smoky-gray in color, is also edible when young and tender. Only one species in this entire group is poisonous, and that one is also very bitter and exceedingly rare.

Not only the polypores but also the boletes are neglected. These are



HORN OF PLENTY

fleshy fungi with tubes and a stem, occurring on the ground, while most of the polypores are tough or woody and grow on the trunks of trees or upon dead wood in the form of brackets. There are about 80 kinds of boletes in North America and nearly all of them are edible. A few are bitter and two are



Left: FLUTED BOLETE
Right: A CORAL FUNGUS

slightly poisonous; these are the sensitive bolete, which turns blue immediately when touched, and the lurid bolete, which has red or orange tube-mouths.

As an example of this group, I might mention the rare and beautiful fluted bolete, found occasionally in deciduous woods from Virginia to Alabama and westward to Ohio. Its unusually tall, yellow stem is decorated with reticulations and deep grooves, giving it a shaggy appearance; while the viscid, shining cap is reddish or egg-yellow,



LACTARIA PIPERATA

becoming darker with age. The pale flesh is slightly acid, but very palatable; only there is not enough of it. However, many of the boletes occur in great abundance and their flavor can hardly be excelled.

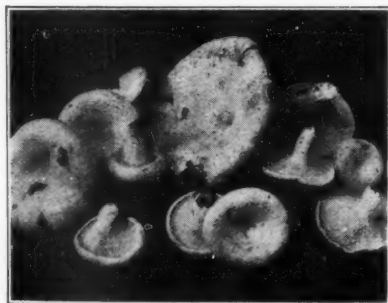
Many of the coral fungi are no doubt eaten because none of them are poisonous, but the great majority go to waste. I knew one woman who started out very enthusiastically to collect the corals, but gave them up because she

happened to get a bitter one the first time. This was discouraging, I will admit, but a little parboiling would probably have eliminated the trouble. Then, too, there is one very common white species that looks like a coral fungus but is too tough for the human stomach. Only fresh, tender specimens of mild flavor and free from insects should be used for food.

Most of the coral fungi occur on the ground in shaded places and are yellowish in color. *Clavaria pyxidata*, however, grows on wood that is dead and usually much decayed. It is of very wide distribution and easily recognized by the cup-shaped expansions at the tips of its branches and by its peppery taste. Its color is pale yellow when young, changing to dull ochre with age or on drying. Even the young, fresh plants are pliable instead of brittle, which is unusual for members of this group.

SPARASSIS is an interesting and rare edible fungus occurring on the ground in woods in the region of New York and Pennsylvania. It is four or five inches high, about six inches broad, and of creamy-white color. A very near relative is often seen in the European markets.

The horn of plenty, sometimes known as the fairies' loving cup, is a good edible mushroom, although unattractive in color and rather small. It occurs commonly in patches in open woods during summer and fall throughout a wide area of distribution in temperate regions. It is only two or three inches high, thin, rather flexible, trumpet-shaped, blackish-brown, and more or less scaly above.



LACTARIA PERGAMENA

There is a large group of mushrooms readily known by their milky juice, but some of them are poisonous and it requires an expert to distinguish all the species. *Lactaria deliciosa*, with orange-



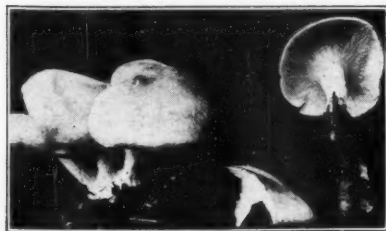
IVORY HYGROPHORUS

colored milk; *Lactaria lactiflua*, with abundant white milk; and a few other species are commonly eaten by those who know; but one must be continually on the watch for *Lactaria rufa* and others of its category.

TWO species of this group are of special interest because they are not only edible but also exceedingly abundant and easily recognized. One is *Lactaria piperata* and the other *Lactaria pergamena*, both of them white and very peppery. The resin, "piperon," which is extremely acrid in the fresh state, is disorganized by heat and rendered harmless. Most of the acrid species with milky juice that are considered poisonous have other good characters separating them from these two.

Lactaria piperata occurs in dry oak woods throughout temperate North America, as well as in Europe. It reaches about four inches in diameter, is deeply depressed at the center, and has white milk that does not change color on exposure to the air. *Lactaria pergamena* differs in being somewhat smaller, with more crowded gills and less peppery milk, which sometimes changes to pale green on exposure. The white caps sometimes have yellowish or buff shades and the gills of fresh plants turn honey-yellow where wounded. This species is extremely abundant in oak woods from mid-summer until autumn. I frequently pick a basketful without moving from my tracks. It is best to parboil it and throw the first water away.

The ivory hygrophorus is an attrac-



FRAGRANT CLITOCYBE



MANY-HEADED CLITOCYBE

tive edible species widely distributed throughout the cooler regions of Europe and North America, occurring in moist woods or partially shaded places. I have found it very abundant on the Pacific coast, as well as in many parts of the eastern states. Its white color, slimy covering, mild odor, and distant, decurrent gills will serve to distinguish it. The caps rarely reach three inches in breadth.

THE rooting collybia is very fond of beech trees and I usually find the small, typical form in the vicinity of beech trunks or stumps, with its long rooting base attached to a dead root. The cap is about two inches broad, viscid when moist, grayish or umber; and the tall, slender stem white above and grayish below. Although small, the plants occur in groups and keep coming up for some time. A much larger form with hairy stem is less commonly seen in open deciduous woods; but both forms are widely distributed and of good flavor.

The fragrant clitocybe, with an agreeable anise-like odor, is not so abundant, but has unusual and beautiful colors. It loves deep leaf-mould in woods or wood borders, being found in this country from Maine to North Carolina and westward as far as Michigan. The cap is two or three inches broad, green or dingy-green (a rare color in mushrooms), fading with age or on drying. The short stem may be either white or greenish.



FOREST MUSHROOM

The many-headed clitocybe is such a valuable edible species that it should be cultivated, yet few persons know it or make use of it. It grew so abundantly on my lawn in New York that I often had mushrooms in plenty for days at a time without going away to collect them. Its flesh is so firm that it could be shipped clear across the continent, I

believe, with little or no deterioration. This species is white or very slightly grayish and grows in large, dense clusters, the individual caps measuring from two to three inches in breadth.



ROOTING COLLYBIA

Unfortunately, the distribution is rather limited, so far as is at present known.

IT is a little dangerous to recommend the smooth lepiota for food, because it might be confused with the destroying angel; but it is an excellent species, nevertheless, occurring abundantly on lawns and in pastures where the common meadow mushroom grows and readily distinguished from it by its white gills. The cap is two or three inches broad, white or slightly yellowish; and the stem smooth, white, bulbous below, and decorated above with a white ring. As the gills become old, they change to a dull pink. There is no death-cup as in the destroying angel; which, moreover, is a woodland species. If there is any doubt, better keep on the safe side!

The forest mushroom, of the same group as the common meadow mushroom, is a very attractive white species of wide distribution in open woods and wood borders, distinguished from the well-known horse mushroom by its smaller size and more simple veil. The cap is from two to four inches broad, white at first, becoming tinged with straw-color in age or when drying; the gills pale reddish-gray to dark-brown; and the stem white, abruptly bulbous below, with a large white ring above. If one can find enough for a mess, he will be amply rewarded for his search.

Hunting mountain goats with a camera is a sport as exciting as hunting them with a gun. An article in a coming issue will tell the interesting story of such a hunt.



SMOOTH LEPIOTA

Tailor-Made Weather for Offices

Equipment in an Office Building in Texas Supplies Air of Proper Temperature and Humidity to All Offices

By RUEL McDANIEL

LAST August a new tenant in the Milam Building telephoned from an upper floor and complained that his office was too hot.

"Is your window open?" the superintendent asked.

"Why, certainly," the irritated and uninitiated tenant replied, "but that doesn't seem to do any good."

"Well," instructed the superintendent, "please close it at once."

This was strange advice to the new tenant, who had not acquainted himself with the novel facts concerning the new office building, as it is strange information for almost everyone who hears it; because the Milam Building in San Antonio, Texas, is one of the few office buildings in the world which have their own private "weather men" for manufacturing weather to suit the needs of their tenants.

ALTHOUGH for some years certain buildings, notably theaters, have been mechanically cooled—and theater cooling has progressed rapidly during the past three years—the Milam Building is the most completely equipped and most modern of any office structure in which an attempt has been made to regulate the temperature in a manner other than by natural ventilation in summer and artificial heating in winter. Because of the signal success which has crowned this large-scale venture in the regulation of the "weather" in office buildings, the Milam Building obviously represents the beginning of a definite trend in modern building construction. Many engineers who have seen this Texas building predict that within five to ten years it will be the exception for a modern office structure to be erected without equipping it with its own weather-making plant.

The Milam Building is a weather-world in itself. Theoretically the structure is air-tight, but actually there is an air leakage of about 5 percent. Regardless of how hot Texas weather may be outside in summer, the normal temperature of every office in this building is under 80 degrees in summer and above 70 degrees in winter, providing all tenants obey the rule against

the opening of windows; and regardless of how cold it may be outside in winter, the temperature in every nook of the building is kept at the same comfortable level with but little variation. Yet a tenant may have the temperature in his own office regulated to his individual taste.

In summer when the humidity outside is stifling and perspiration pours in great beads off the brows of those

there in this building is supplied with sufficient moisture at all times, and contracting colds by occupants is virtually impossible.

The fact that all air near the surface of the earth is heavily dust-laden is an important factor in the operation of the air-conditioning system of the Milam Building. Dust particles are bacteria carriers. Consequently to breathe dust-laden air not only produces inefficiency on the part of workers, but it is downright unhealthy. That is why, engineers point out, it is desirable that all breathed air be washed before it is used, and washing the air that is used in the building is a big part of the job of the Milam Building's mechanical weather man.

Over-heating in summer causes fatigue and slows down workers; ordinary heating methods in winter lower the relative humidity of the air which, in turn, irritates the throats of those who breathe it, thereby subjecting them to colds and the ravages of other germs which ride upon the thousands of dust particles floating freely in every cubic foot of unwashed air.

THE modern weather-making equipment, therefore, performs two general functions: It regulates the temperature and humidity of the building; and it washes and purifies the air that circulates within the building.

Although the water which washes the air of the interior of the structure is cooled to a temperature of about 45 degrees and the weather plant has a refrigeration capacity of 375 tons a day, no ice is employed in this cooling and weather-making system. Two refrigeration units, employing a water-like liquid, cool the water to the desirable temperature through a process of compression and evaporation. The water in turn controls the temperature of the air which is washed by it.

Theoretically, every cubic inch of air that enters the building is artificially cleansed and regulated; but actually there is an inward leakage through the elevator shafts and lesser openings amounting to a small percentage of the total air in the structure.



AN INDIVIDUAL "WEATHER WORLD"

The building in San Antonio which has the most complete weather-making equipment of any office structure

who must move around, inside the Milam Building the humidity is reduced to a point so low that perspiration evaporates quickly after it comes to the surface of the skin and no one realizes that there is any perspiration. In winter when the average room is filled with air having a very low relative humidity due to the usual methods of heating, the manufactured atmos-

There is a net loss of about 5 percent of the air in the building, through the same leakage escapes.

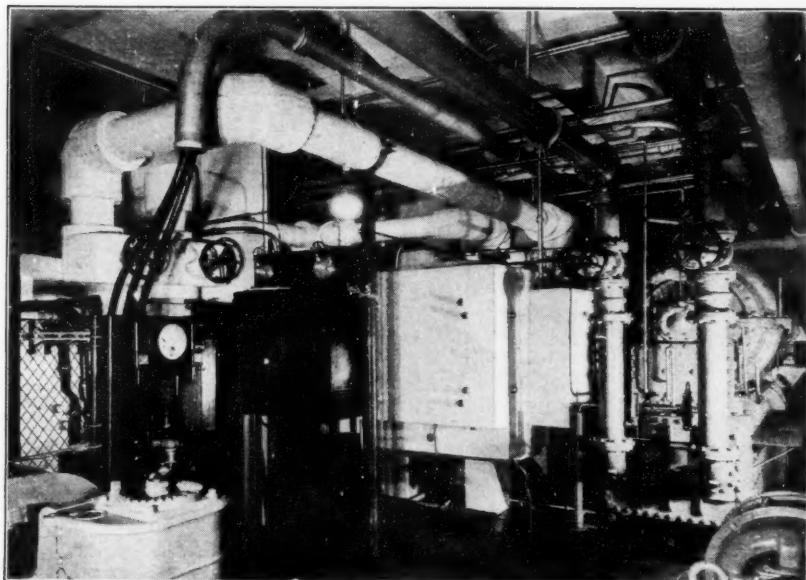
Under the system's normal control, it supplies 100 cubic feet of purified air per minute per person in the building, upon the basis of normal occupancy. The system provides a total of 210,000 cubic feet of air per minute. There is a complete change of air throughout the building every seven or eight minutes if all inlets and outlets in the various offices are normally open. The air-conditioning plant handles eight tons of air a minute!

Fresh air enters the building via the weather conditioning plant through a series of ports on the north side. A set of fans draw the air in from the outside, pull it through the spray of water, and discharge it, purified, into the various ducts for distribution throughout the building.

THE spray chamber is the heart of the weather plant. It is here that the air is both washed and conditioned to fit the needs of the average human system. The outside atmosphere brought in by the fans, is driven into this spray chamber which is almost airtight. Inside this chamber are vertical standpipes into which spray nozzles are screwed. Water is driven into these pipes and forced through the tiny holes of these nozzles under pressure. The result is a dense spray.

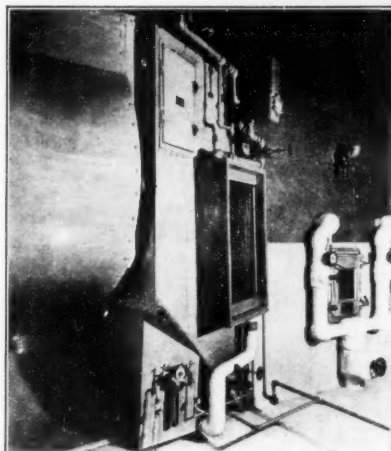
Incoming air is forced through this spray and is thoroughly washed. No air can enter the building without coming through this chamber, save the very small percentage of leakage through the elevator shafts and around the closely fitted outside double-glass windows.

So far, city water has been used in the spray chamber but an artesian well is available and may be utilized later.



SPRAY WATER COOLER

A basement centrifugal refrigeration unit. This equipment cools the water supplied to spray chambers on the various floors



AN AIR CONDITIONER

There are 11 similar sets of this conditioning equipment, each supplying conditioned air to all offices on two floors

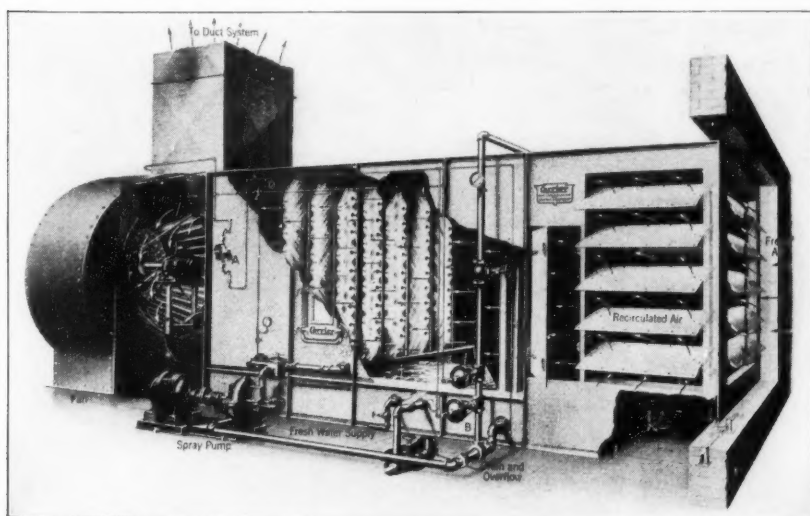
Water is forced through the weather plant at the rate of 1200 gallons per minute. The spray water is itself purified by recirculation, re-cooling, and settling, and is used over and over again.

It is the temperature of this spraying water that governs the "dew-point" temperature of the purified air. Two refrigerating units with a combined capacity of 375 tons of refrigerant per day regulate the temperature of this water. Thermostatic control maintains an even temperature of the water according to the setting of the equipment.

THE water in the spray chamber has a temperature of about 45 degrees. This spray in turn cools the air which passes through it, to a temperature about 10 degrees higher than that of the water.

This does not mean that the cleansed atmosphere is then driven into the various offices at this point. It has been found that the ideal temperature for air under the conditions of operation at San Antonio is about 78 to 80 degrees. So the washed air is brought back to over 70 degrees before being sent on its way to cool the offices of tenants in the Milam Building. The air must be introduced to the offices several degrees lower than the ultimate temperature desired. The heat of the return air is used for tempering the conditioned air wherever necessary. It is then ready to go to the various distributing units throughout the building.

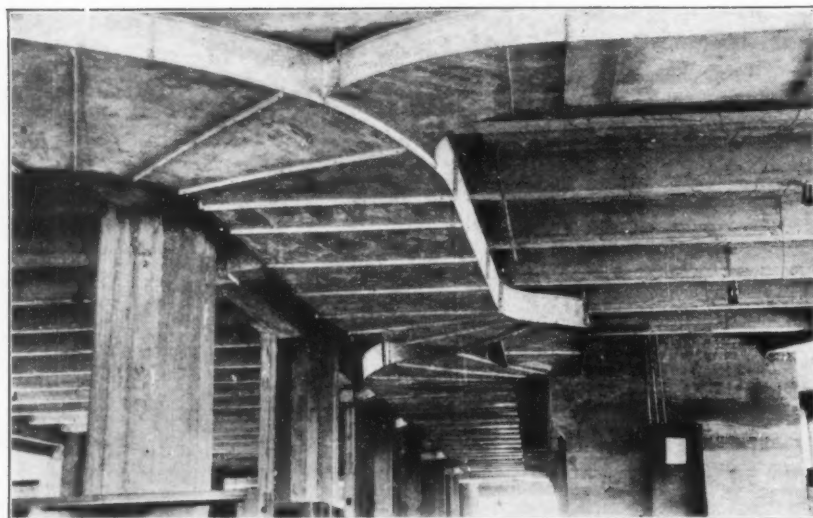
A test shows that this washing process eliminates 95 percent of the dust found in the air at San Antonio. As an indication of the amount of dust and



Photographs courtesy Carrier Engineering Corporation

TYPICAL CENTRAL STATION AIR CONDITIONING UNIT

The centrifugal fan at the left draws air through the automatically controlled dampers at the right, through the spray where it is washed, thence through eliminator plates to the ducts



CONDITIONED AIR DISTRIBUTION

The conditioned air is distributed to each individual office through a metal duct system. This illustration shows the duct system as it was installed during erection of the building.

germs actually removed, dirt to the amount of seven bushels, on an average, is removed from the bottom of the water filter each week; and this is dirt which has been thrown into the clear city water by the incoming natural outside air.

Saturated cold air does not normally hold much moisture; and saturated over-warm air holds too much. By artificially lowering, then raising the temperature of the air which passes through this weather plant, the Milam Building not only maintains the proper temperature but the desired amount of moisture in the atmosphere as well. The air leaving the spray chamber is practically saturated.

IF the fresh air entering the spray chamber from the outside of the building is excessively warm, as in the summer, the spray condenses this excess moisture as it lowers the temperature. If the natural air is cold as it comes into the spray chamber in the winter, it automatically absorbs the proper amount of water and the humidity remains at its ideal of 55 percent. Once the air is humidified or de-humidified, as the case may be, there is no opportunity for it to pick up more moisture.

The water for the sprays is cooled in the basement and delivered to the air conditioning units which are located on the upper floors, one unit generally serving two floors. There are two air conditioning units in the basement, one serving the cafeteria and one serving the stores on the first floor. There are, altogether, 11 sets of air conditioning equipment—the highest one being on the 18th floor—from which clean, properly cooled and properly de-humidified air is distributed to the offices on hot summer days for the comfort of office workers.

The air comes into a typical office through a grille in the wall near the ceiling. It is drawn out through a louvre in the lower panel of the door, carried through the corridors and gently swept, without creating a draught, by suction into pipes through which it is forced back to the plant, where it is mixed with incoming air, put through the weather plant and again purified.

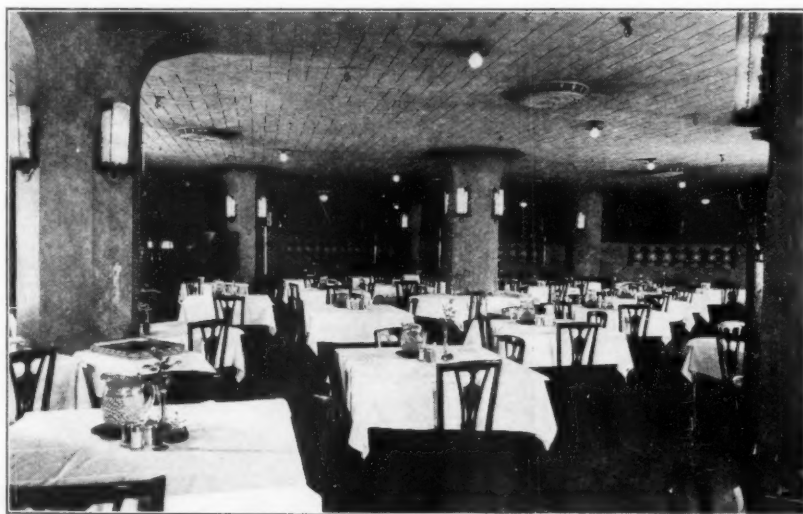
There are dampers on the various distributing units which make it possible to regulate the volume of the air to compensate for the position of the sun during the day. During the summer, for example, the excessive heat on the east side of the building during the morning brings an abnormal amount of heat to offices on that side. By means of the volume damper an extra amount of cooled air goes to these

offices to compensate. The amount is lessened at the same time on the west side, where the shade keeps the offices cool. The reverse is true in the afternoon.

Temperature may be regulated slightly over a range of several degrees in individual offices to suit the wants of the tenants. This is possible because of the adjustability of the grille through which the air enters the room.

OBVIOUSLY, the window ventilation problems in the Milam Building are just the opposite of those in the usual office structure due to the characteristics of its air conditioning system. Here the problem is to keep out all natural air save that which comes through the weather plant. In the usual office, the problem is to make ample natural ventilation available through proper window openings. In this Texas building, windows serve no purpose save for natural lighting. As a matter of fact, they are made as nearly air-tight as it is humanly possible to make them. They have thick plate glass which runs length-wise. They are fitted into heavy steel casements and rest in frames cushioned with felt weather-strips one fourth of an inch thick.

Thus man-made weather, which has become familiar to many of us in the larger theaters and which has already been utilized in the manufacture of textiles, motion-picture film, flour, bakery products, candy, and other commodities, has now proved its value as an agent for promoting greater human efficiency among "white-collar" workers. With the steadily increasing use of manufactured weather equipment, it is not at all improbable that it will, in time, become standard for homes just the same as the furnace is at present.



AIRTIGHT BUT NOT AIRLESS

In the same manner that the offices are supplied with manufactured weather, this restaurant is kept comfortable at all seasons of the year. Note conditioned air inlets in the ceiling.

Sky Photography for Lightning

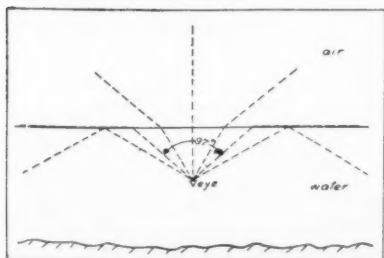
By ROBERT SPARKS*

PHOTOGRAPHS of lightning strokes have always proved valuable in any study of thunderstorm phenomena. The difficulty in photographing lightning, however, is that the flash may happen anywhere in the sky. Therefore, a camera, or cameras, must be provided which embrace the entire sky, or at least the entire horizon.

R. W. Wood, of the Westinghouse Electric and Manufacturing Company, had his attention called to the peculiar view presented to a fish in looking up into the air from the water. A beam of light shining on the water almost parallel with the surface is refracted to an angle of $48\frac{1}{2}$ degrees from the vertical, and a beam coming at an angle between the horizon and the vertical is bent through intervening angles. Thus the fish sees the whole of the sky at once in an angle of about 97 degrees. As he looks more to one side, there is a total reflection and he can see the bottom of the pond. During a vacation by a lake in Maine, the writer took the opportunity to determine exactly how much a fish really could see. Upon swimming down into the water and looking up he found that the shore and a boat on the opposite side of the lake and the bottom of the lake on the shore side were all clearly visible at once.

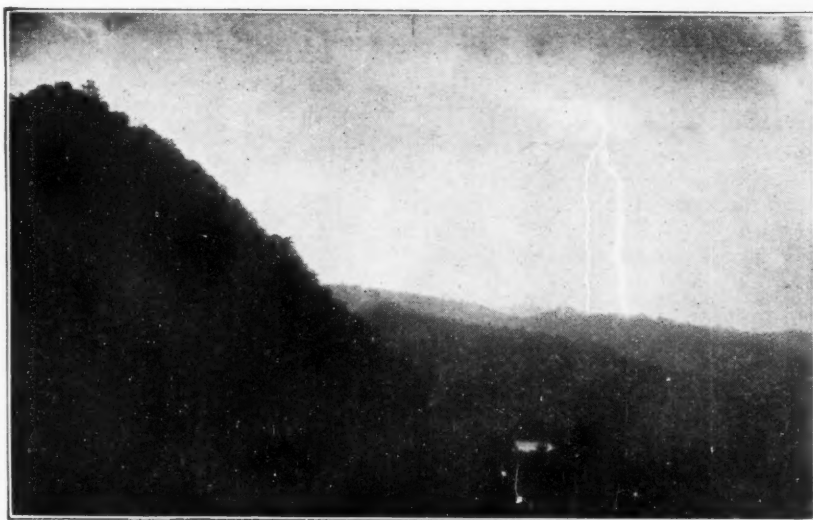
Mr. Wood filled a pin-hole camera with water, and put a glass plate in front of the film to protect the film from the water. In this way he took pictures which he called "fish-eye" views. Mr. Wood's "fish-eye" camera was the first of its kind and while it was very interesting, it produced great distortion and was somewhat incon-

*Engineering Department, Westinghouse Electric and Manufacturing Company.



WHAT A FISH SEES

Looking up, the eye of the fish has the visual field indicated by the dotted lines

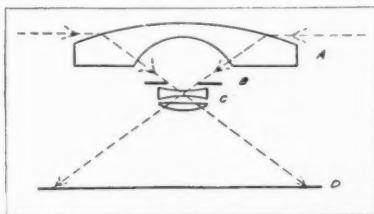


ENEMY OF POWER TRANSMISSION LINES

In the lightning investigation in the Tennessee mountains, photography of flashes is important. Photographic records, with other data, are expected to solve power-line problems

venient to operate. W. N. Bond and Robin Hill independently made systems of glass spheres for lenses to produce a similar sort of picture. Mr. Hill later developed a lens giving equidistant projection.

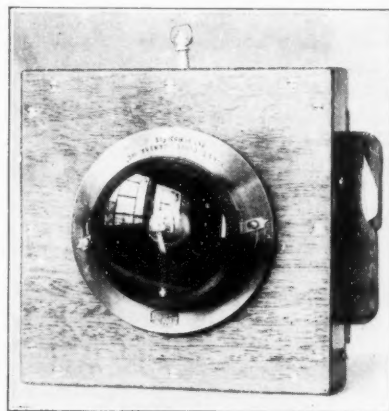
One of our illustrations shows the lens system devised by Mr. Hill: "A" is the lens with a spherical surface which refracts the rays of light into a cone of about 90 degrees; "C" is a wide angle lens system giving a projection on the film "D"; at "B" is a provision for a color filter, since it is difficult to make a whole-sky system achromatic. With this projection, the photograph of a circle will appear as an ellipse toward the edge of the film, one diameter remaining always the same, the other lengthening.



HILL'S LENS SYSTEM

With this system, a 180-degree angle is covered. See text for full description

Whole-sky pictures taken with the Hill camera are very distorted near the edges. The camera has, however, the decided advantage that sections of a picture may be enlarged and corrected by reversing the action of the lens. This converts any section into a normal view as taken by the usual camera. The negative is mounted in the camera with a light behind it and the plate is placed in front of the camera. Thus for a normal view of a section near the horizon the plate is put at the desired distance and *parallel to the axis of the lens*. As a test of the



THE FISH-EYE CAMERA

When pointed to the zenith, this camera "takes" the sky from horizon to horizon

accuracy of this method, a picture was taken by Hill of the columns in the nave of Ely Cathedral. A section of the distorted view, including one or two columns, was then enlarged and corrected by this method. The result was a normal, clear photograph with all the columns appearing straight.

In using this camera to photograph lightning, it is set up with the shutter open. It will then record on the negative a lightning stroke occurring anywhere in the heavens. After development, any section showing a flash may be enlarged and corrected into the sort of picture with which we are all familiar. It is, of course, easiest to obtain lightning pictures at night when the camera can be left open until after a stroke, but it is also possible to obtain lightning pictures during day storms when the clouds are heavy.

Two of these cameras may be used to take stereoscopic pictures. The two cameras may be set a quarter of a mile apart and the two exposures made at the same instant.

Estimating the Age of Writing*

Whether a Document Is Authentic May Usually be Discovered by Analysis of the Writing. In Legal Cases Such Methods Are Often Crucial

By C. AINSWORTH MITCHELL, M.A., F.I.C.
Secretary to the Society of Public Analysts

IT is often of the greatest importance to be able to form some opinion of the approximate age of the writing in a document. The question usually presents itself in one of two forms: Is the writing as old as it purports to be? or, Was the whole of the writing upon the document done at the same time—if not, which part was written first?

An answer to either question is possible only under certain conditions, which postulate a difference in the physical condition of the original pigments, or a chemical change in a pigment causing it to alter its original physical characteristics. In the absence of such original or eventual differences no opinion can be formed. For example, in the Seddon murder trial (1912) the accused produced a notebook as a proof that he had paid a weekly rental to his victim. The entries extended over a period of more than a year, and there was some reason to believe that the entire series of entries was spurious and written, not week by week, but all at one time. They had all been written with copying-ink (indelible) pencil, and the pigment was the same throughout the series.

BUT, except for the improbability that the same kind of copying-ink pencil should have been used weekly without a break, over so long a period, there were no data upon which any judgment could be based as to the relative ages of the first and last entries. This was inevitable because the pigments of copying-ink pencils consist of mixtures of graphite, aniline dye and China clay, and do not change when applied to paper, apart from some fading of the dyestuff after many years.

Ordinary writing ink, on the other hand, undergoes a progressive series of changes as the air acts upon it on the surface of the paper, and a study of these changes has enabled some approximate relationship to be established between them and the time that has elapsed since the ink was applied to the paper. The nature of the changes involved in the drying of ink can best be investigated by exposing freshly prepared ink to the air for long periods in open vessels, and separating and analysing the insoluble films which

successively form upon the surface. When first made by mixing an infusion of galls or other source of tannin with copperas (ferrous sulfate), ink consists essentially of a nearly colorless solution of ferrous tannate. When this liquid is exposed to the air it slowly darkens and is oxidized progressively to a series of iron tannates. The first of these forming a film on the surface of the liquid contains 5.53 percent of iron and is readily soluble in very dilute acid, but is not quite insoluble in water. Hence, writing freshly applied to the paper will yield a copy for a day or so when pressed on to moist absorbent paper.

As the oxidation of the ink proceeds, a second iron tannate containing 8.1 percent of iron is formed. This is resinous in character, is quite insoluble in water, and is much more dif-

ficult to dissolve in dilute acids. It also envelops within itself the particles of any soluble dye present in the ink, and to a large extent prevents smudging when the writing is treated with dilute reagents. This stage requires at least two or three years before it is complete, and it is on the distinctive differences between the two tannates that chemical tests for the age of ink in writing depend, although, as recent work has shown, the mixtures of the tannates are of variable composition and may contain absorbed tannin. The change of color in ink on paper takes place very rapidly at first, but after a day or two the rate of alteration slows down, although the final stage of darkness is not reached, under the usual conditions of protection from light, until after the lapse of many months. The change in the color of the ink can be followed and recorded by the use of a combination of the tintometer and microscope. The principle of the tintometer is the matching of a color with a standardized series of red, blue, and yellow glasses, which, when superposed, transmit light to enable a record to be taken of any color. Osborn's comparison microscope has been adapted for use with the Lovibond tintometer glasses. This microscope has two tubes, each having its own objective and with their upper ends fitted with a prism box by means of which the images seen through the two objectives are brought into juxtaposition beneath a single eyepiece. In using this instrument for the examination of ink in writing, one of the tubes is focused over the writing, while the standard Lovibond glasses are placed in a slot in the other tube, and a record is taken of the glasses required to match the color of the ink.

FOR example, a blue-black ink freshly applied to the paper gave a reading of three blue units on the Lovibond scale, but after an hour or two red and yellow units also appeared, and after ten months the color was matched by blue, 3.5, red, 9.7, and yellow, 0.2 units. Commercial iron-gall inks usually contain an added aniline dye to give color to the writing pending the formation of the dark iron tannates, and the well-known color changes that occur when such an ink dries on paper are the result of the gradual masking of the blue dye by the progressively darkening series of iron tannates.

It is obvious that such a record of the color of an ink may afford valuable information as to the age of writing, but by way of illustration an actual instance, within the last twelve months, may be cited.

A tradesman had insured his stock of textile materials with a London insurance company, and some time later was the victim of a fire which destroyed his shop. As a proof of what had been lost he produced a notebook containing lists of goods purchased over a period of two years. The insurance company doubted the genuineness of these lists, which they had grounds for believing had been compiled soon

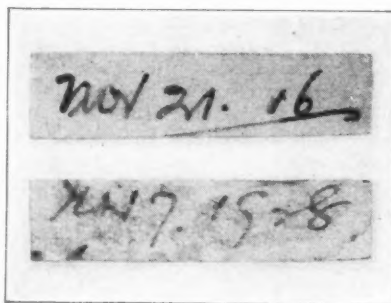


FIGURE 1

Treatment with a bleaching agent or dilute acid serves to reveal the age of writing

After treatment with a bleaching agent or dilute acid, the ink on the top piece of paper remains dark, while the ink on the bottom piece is significantly lighter, revealing its age relative to the top piece.

After treatment with a bleaching agent or dilute acid, the ink on the top piece of paper remains dark, while the ink on the bottom piece is significantly lighter, revealing its age relative to the top piece.

* Reprinted, by permission, from *Discovery* (London).

after the fire. Colorimetric tests applied to the writing confirmed this suspicion, for the ink in the writing in the beginning of the lists (as well as that at the end) changed its color after the lapse of a few days, and therefore could not have been two years old. The insurance company did not pay the claim, and the case did not come into court.

The formation in writing of the resinous tannate mentioned above is indicated chemically by the behaviour of the ink on treatment with dilute acids or bleaching agents. If, for instance, writing in blue-black ink freshly applied to the paper is treated with two percent hydrochloric acid, it will rapidly smudge and the blue dye will "run," but if the writing is some years old the ink will resist the reagent, and the blue dye will not be dissolved (see Figure 1).

THE first occasion on which evidence based on this chemical method was given in a court of law was in 1911 at the trial of Colonel Pilcher, who was accused of forging his cousin's will. This document purported to have been signed twelve years before the date of the trial, and both of the alleged witnesses to it were dead. On treating various parts of the will with dilute reagents all the ink in the body of the will, and each of the signatures, rapidly ran and the blue dye made smudges over the surface of the paper. Tests applied in the same way and under parallel conditions to the counterfoils (stubs) of check books of the alleged testatrix caused rapid smudging in those only one or two years old, but had hardly any action on those three or four years old, and practically no effect on the writing five or six years old. Evidence to this effect was given at the trial to prove that the writing upon the will could not have been twelve years old. Ultimately Colonel Pilcher confessed that he had uttered the will knowing it to be a forgery, and was sentenced to three years' penal servitude.

If some of the ink upon a document, the whole of which purports to have been written at the same time, is found to be of a different kind from the rest of the ink, it naturally raises a suspicion that a later addition has been



FIGURE 2

The figure 200 was raised to 2000, as revealed in the chemical laboratory

made to the document. The methods of determining this may be photographic or chemical. A good illustration of this kind of test is afforded by the case of *Rex v. Cornwallis* (1921), in which a woman was tried on the charge of forgery. She had received a letter acknowledging the receipt of £200, but claimed that the actual amount was £2,000 (see Figure 2). To the naked eye the final "o" appeared closely similar to the rest of the amount, but it happened to be in an ink containing less blue dye, and therefore affected a photographic plate very differently, as is obvious in the illustration. The accused woman was convicted of the forgery and sentenced to a term of imprisonment.

But a difference in ink may not always be conclusive of fraud, for the ink itself may produce variations in the writing. This was shown in the *Howes will case* (*Skelton v. Howes*, 1924), in which a will was found six months after the death of the testator, and appeared suspicious owing to the signatures having been retouched and some of the ink showing a difference of color.

AT the request of the judge I was called in to investigate the will, and found that the abnormalities in the ink were due to three bottles of ink, bought at a sale, having been mixed together, so that the appearance of the ink depended upon the depth to which the pen was dipped into the mixture. The ink also left the pen rapidly and this explained the necessity for retouching some of the signatures.

Conclusive evidence as to the priority of two pieces of writing is sometimes furnished by the fact that one stroke has happened to overlap another, and that it may be possible to see which stroke is uppermost and

therefore the more recent. But the test is not quite as simple as might appear, as has recently been shown by Ward and the writer (*Analyst*, 52, 582).

If two strokes are made to intersect at the time of writing it is quite impossible to decide which was made first, for the ink in the two strokes mingles and the insoluble tannate forms simultaneously in each. If, however, a few hours are allowed to elapse between the making of the first and second strokes it may be possible to decide which is uppermost, although one cannot be certain that mingling of the two strokes will not occur, until after about 48 hours' interval between the strokes. Blotting renders the judgment uncertain, especially if the blotted line is uppermost, although when the first line has been blotted and the second has not, it is usually possible to see distinctly that the insoluble pigment is above the first stroke.

A series of systematic experiments (Figure 3) extending over two years has shown that in all cases the possibility of deciding which of two intersecting lines is on top depends upon the physical condition of the two pigments; if one of them is transparent, as in the case of the dye in colored writing inks or in certain typing inks, the differentiation of the sequence of the strokes is uncertain. If, however, the conditions necessary for the formation of an opaque pigment in the uppermost line are present, there can be no doubt that the line which appears to be on top really is uppermost.

THE remarkable value of the method was shown by a case heard in the Probate Court in 1924. A testator had added a codicil to his will, which altered its tenor. A few strokes in the writing of this codicil intersected strokes in the signature, and microscopical examination showed that the codicil had been written after the original will was signed. The latter was therefore ordered to stand.

When you stop to think of it, the ordinary clothing a man wears is a fit candidate for a thorough revision. Hot, stuffy, stiff, costly, inefficient—no scientist, no engineer, would tolerate a comparably crude arrangement of equipment. On this, next month, there will be an article.



FIGURE 3

Left to right: Logwood ink strokes crossed immediately. Blue-black ink, on blue-black ink, blotted. Same inks, 48 hours between strokes. Lead pencil on black ink. All $\times 13$

Earth Shine

From the Moon the Earth Would Appear Many Times as Bright as the Moon Appears from the Earth. Interesting New Research on an Old Subject

By HENRY NORRIS RUSSELL, Ph.D.

Chairman of the Department of Astronomy and Director of the Observatory at Princeton University
Research Associate of the Mount Wilson Observatory of the Carnegie Institution of Washington

WITH so many observatories scattered over the world, and so many astronomers at work in them, it might be imagined that everything which can be seen directly with the eye had long ago been observed to the "saturation point." It is true that much of the work of the present is done with powerful instruments upon bodies quite invisible to the naked eye, but now and again some good piece of work is done with small instruments upon familiar objects.

An excellent instance comes from the Observatory of Strasbourg where a young French astronomer named Danjon has been doing photometric work of notable interest. Much of this has been accomplished with a new instrument of his own invention which he calls the "cat's eye photometer." In this ingenious device the light of one star, coming through the main part of the objective of a telescope, is compared with that of a brighter star which has passed through a small square of adjustable size (the "cat's eye"), and then by reflection into the telescope. By adjusting the size of the aperture the two images are made to appear equally bright.

THE first instrument to be constructed had a telescope only three inches in aperture and two feet long, but a long series of observations upon Algol showed that it gives results of remarkable precision. All the characteristics of the star's variation, including the small secondary minimum due to the eclipse of the faint companion by the bright star, are clearly shown.

Having then demonstrated the value of his new instrument, Monsieur Danjon has applied it to the study of something which has been known for centuries but has never before been accurately measured. Everybody has seen "the old moon in the new moon's arms." When the crescent, whether waxing or waning, is visible in a clear, dark sky, the outline of the rest of the moon's disk is clearly perceptible. With a field glass (or with the naked eye under the best conditions) the familiar dark spots may even be seen upon the faintly lighted surface. Almost everyone knows, too, that the faint illumination arises from sun-

light reflected by the earth to the moon—"earth light" on the moon—exactly similar in nature to moonlight on the earth but brighter. When the bright sunlit crescent is there, the "earth shine" is easy to see, but for a half moon it is barely visible. There are two reasons for this: the half moon is brighter, and its light drowns the earth shine out; and at the same time an observer on the moon would see only a "half earth" instead of a nearly full earth, and the earth shine would obviously be fainter.

From measures of the brightness of the earth shine it should be possible to determine how much light the earth reflects, and also how the amount of reflected light falls off with changes in the earth's phase. But although the earth shine is easy enough to see, it

upon it, but were not precise enough to show the changes with phase. Monsieur Danjon proceeds by comparing the earth shine as received directly with his three-inch telescope with an image of the bright part of the moon cut down by his "cat's eye" and further weakened by reflection from unsilvered glass surfaces; and his results are of quite a different order of accuracy than anything which has preceded them. Since the images of the bright moon and the earth shine are visible in the same field and on the same background, the troublesome correction for the latter is almost abolished; and since the whole surface of the moon is in sight it is possible to make allowances and to compare the average brightness of the sunlit and earthlit portions.



Copyright American Museum of Natural History

LUNAR LANDSCAPE

Painted by Howard Russell Butler, N. A.
The earth's tropics are shrouded by clouds

is very difficult to measure. It is faint and badly mixed up with the light of the sky—that is, with ordinary moonlight scattered by the earth's atmosphere. Moreover, the moon's surface is spotted and of very irregular brightness.

Several observers have attacked the problem, the first being the late Professor F. W. Very. Their results agree in showing that the earth reflected about half the light which fell

MEASURES on more than 50 nights show very clearly that the earth shine wanes rapidly as the moon waxes. When the moon is a thin crescent about 30 degrees from the sun (see sketch, upper position) the earth shine is about one thousandth as bright as an equally large portion of the sunlit crescent; at the half moon (second position, in sketch) it is less than one ten-thousandth as bright; and when the moon is 120 degrees from the sun (third position, in sketch) the earth shine has sunk to one forty-thousandth of the brightness of the rest of the disk and can be followed no longer.

To find from these measures what is the real brightness of the earth shine falling on the moon takes a bit of calculation. The average brightness of the sunlit part of the earth's surface is not always the same, but falls off rapidly from the full phase (when it is greatest) toward the quarters. This happens partly because the sun's rays strike it more obliquely, but still more because the moon's surface is very rough. At the time of full moon every mountain, and for that matter every loose rock, hides its own shadow from us. But as the moon departs from the full the shadows come out more and more. The average apparent brightness of the visible surface is thus reduced at the half moon to only one fifth of that of the full moon; while for the crescent 30 degrees from the sun the brightness is

only one twenty-fifth of that which would be shown by a "shaving" of the full moon of the same apparent width.

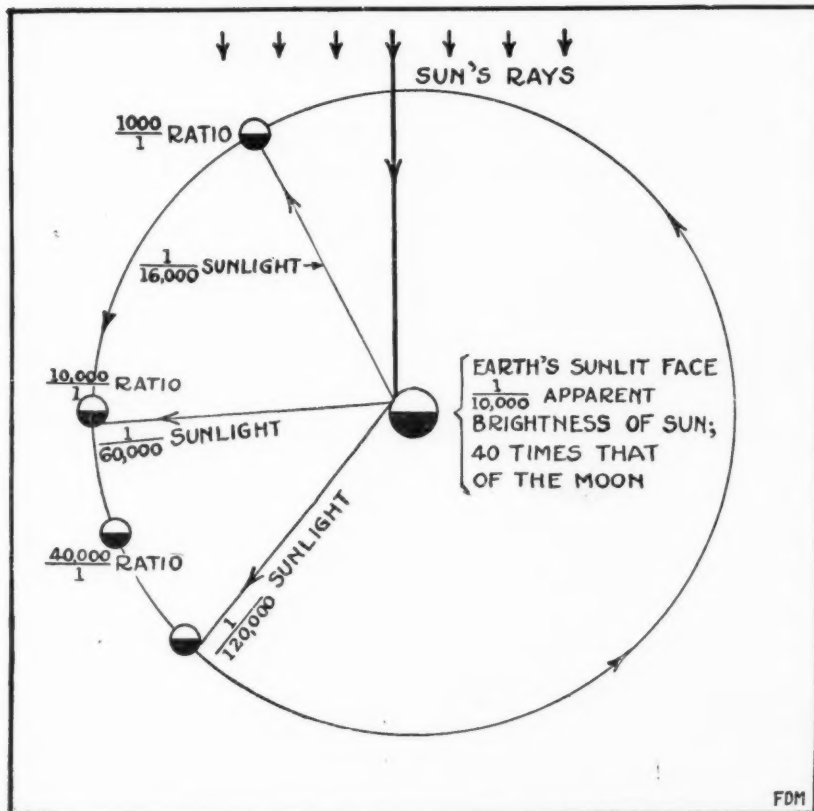
This effect is remarkably great and it has long been realized that it shows that the moon's surface must be exceedingly rough. The shadows of the visible mountains would suffice to account for but a small part of the observed change, and it is probable that the greater part of the moon's surface is either covered with loose material like the rock piles at the foot of a cliff or is tumultuously rough like the hardened surface of a lava flow. Both of these hypotheses are obviously consistent with what we know otherwise about the lunar surface.

Making allowance for this, Danjon calculates the ratio of the brightness of the earth shine to that of the full moon, which is obviously the ratio of the brightness of sunlight and earth light as seen by an observer on the moon's surface. When the moon is 30 degrees from the sun the earth, which would then show almost the full phase to a lunar observer, lights up the moon's dark surface about one sixteen-thousandth as strongly as the sun does.

At the half moon and half earth this fraction has decreased to one sixty-thousandth, while the terrestrial crescent, when reduced to half the width of the half phase, would give but one one-hundred and twenty thousandth of the sun's light. From a plot of these data a reasonably safe extrapolation can be made over the relatively short interval back to the full earth, which is thus found for a lunar observer to be one ten-thousandth as bright as the sun. This is more than 40 times as bright as the moon appears to us at the same distance. The earth is of course much bigger, but this would account for only a fourteen-fold difference. The excess indicates that the earth's surface is a much better reflector of light than the moon's.

Qualitatively this was certain in advance of any measures, for the earth is largely covered with clouds; and even when it is not, its atmosphere would reflect about as much light upward into space as it sends down to the surface to form the blue sky. Compared with these the light reflected from the land and water surface is doubtless of minor amount but the moon has no atmosphere and a surface of bare rocks. A difference in the observed direction was to be expected and the observed amount, which makes the earth as a whole three times higher in reflecting power than the moon, is also reasonable.

One might expect, too, that the earth light would be bluer than the moonlight, or even than sunlight; since clouds are white and the sky is blue. Danjon has tested this by making observations on especially fine nights



APPARENT VERSUS REAL BRIGHTNESS OF EARTH SHINE

The apparent brightness of earth shine on the moon is not a measure of the amount of light impinging on it's surface; the former takes account of the amount of light reflected back to the instrument or eye on the earth; the latter only of the light received on the moon

through red and green color screens. Four evenings' work agreed closely in showing that, observed in green light, the earth shine is one third brighter compared with the crescent than when seeing with red light. Observations in blue light, which would have doubtless shown a still greater difference, are not practicable owing to the faintness of the earth shine.

Between the full phase and the half phase the light reflected by the earth drops to one sixth of its value, as against one tenth for the moon. It follows that the surface of the earth is not as rough as the moon's. This was again to be expected; at first sight, indeed, one might have anticipated a still greater discrepancy in the two cases.

The light of the blue sky and that reflected from smooth layers of cloud or fog might be expected to show a smaller loss at half phase. Very vivid memories of cloud surfaces seen from below from an airplane suggest to the writer that the roughness of the earth's reflecting surface is mainly that of the tumbled upper face of the broken clouds, and clouds act as efficient reflectors.

To determine the albedo of the earth (that is the fraction of all the sunlight falling upon it which is reflected away again) it is necessary to

take an average for all phases. The result comes out to be 29 percent, which is smaller than has previously been calculated from the known cloudiness of the earth. The exact value of this figure depends on the precision of the large corrections which have to be made for the action of the devices which have to be adopted in the photometer to weaken the direct image of the crescent so as to make it comparable with the earth shine; but Danjon's value is nevertheless very much better than any previous determinations by observation.

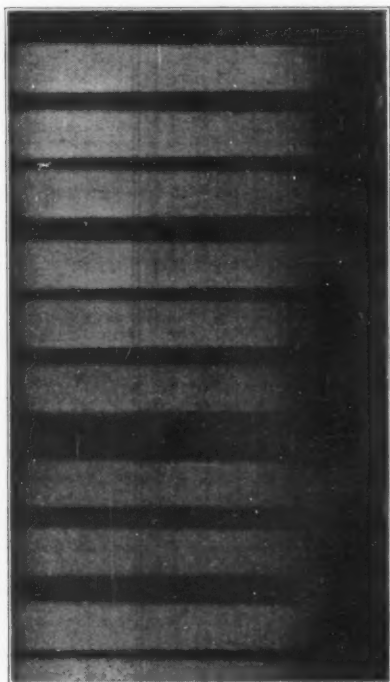
It may finally be remarked that the moon at the time of a total solar eclipse is illuminated by a full earth, the loss owing to the moon's shadow on the latter being small. It should therefore be somewhat brighter than the earth shine is at any other time. Danjon's data make its stellar magnitude minus 2.5, more than twice as bright as Sirius and brighter than Jupiter. During an eclipse, of course, the moon is seen against the background of the corona, which is many thousand times brighter than this, and it therefore looks black. It might be interesting, however, when the moon is thin to compare the earth shine directly with an out-of-focus image of a bright star that looks to be about the same size.

The Ultra-Violet From the Sun

A Ridiculously Small Quantity of Ozone in the Atmosphere Controls the Amount of Ultra-Violet Which Reaches the Earth's Surface

By RICHARD RUEDY, D. Sc.
Research Physicist

SUNLIGHT, when it is passing through a wedge of glass, gives the well-known rainbow colors—a band of red, yellow, green, blue, and violet. That is as far as the eye sees it. But there are other "colors," invisible to the eye, at both ends of the band or spectrum. If upon a screen, we should mark off the point where the violet ends, and photograph the spectrum, the plate would show an extension beyond the violet, because the plate or film is sensitive to a greater range of "colors" than the eye.



SPECTRUM OF SUN

Figure 1: Spectrograms made at equal intervals during last hour before sunset (note space), and early after sunrise the next morning. Here, as on page 34, the short wavelengths are shown at the right

The sun's spectrum is not quite uniform and its end is not quite sharp, at least not when produced by a good wedge or prism of glass, or better, of quartz. (See Figure 1). There are dark and bright bands in the ultra-violet region, and the extent and darkness of the bands change with the hours of the day. Nor is the end of the spectrum always at the same point. As the sun rises higher and higher during

the first morning hours, the spectrum extends farther and farther into the invisible region.

As the sun sets, the reverse change takes place, the dark bands, which were scarcely noticeable at noon, become sharper and sharper and cut off more and more of the ultra-violet light. The light from the sun has at that hour and after sunrise a much longer path to travel through the atmosphere than at noon, and if the air were not quite transparent to ultra-violet radiation, it would be easy to understand why the ultra-violet is weakened in the evening and in the morning.

An accurate study shows, however, that the ultra-violet which reaches us varies often from day to day, for the same position of the sun, and sometimes from hour to hour. Air alone could not cause such a variation.

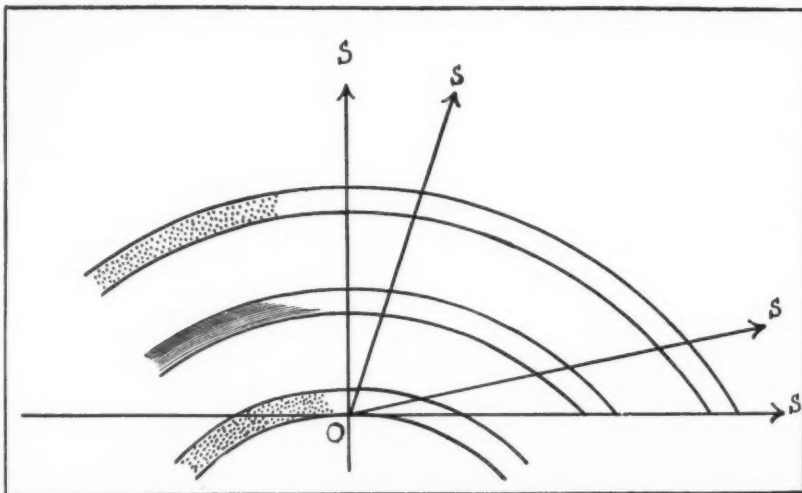
As a matter of fact, air is transparent to these radiations at the "end" of the spectrum and lets them pass freely. Beams of ultra-violet from a carbon arc are often sent over distances at the surface of the earth where they have to pass across more air than would correspond to the entire height of the atmosphere, and afterwards they are not much weaker than those of other colors. The snow-clad mountain tops are visible over large distances, sending the sun's light through a mass of air many times thicker than the at-

mosphere above, and what ultra-violet light reaches them from the sun and is reflected horizontally gets through.

There must then exist a substance higher up in the atmosphere to account for the stopping of the far end of the spectrum.

It is even possible to determine the altitude of the absorbing layer, because the surface of the earth is curved. As Figure 2 shows, if a bank of more or less opaque material is assumed to be at different altitudes, the path of the sun's rays will vary in all of them with the height of the sun. Around noon, the variation is nearly the same whether the bank is at 0 or 50 or 100 miles above the earth's surface. The path depends only upon the direction in which the sun appears. But towards evening, the path will become the longer the lower the altitude of the layer.

BY studying how fast the ultra-violet gets dimmer in the evening and morning hours, it is possible, as Professor Fabry has pointed out, to find by trial or by calculation which altitude will account best for the observed intensity change. Up to the present moment such measurements have only been made in three places: in Montpelier, southern France (1926); in Arosa, Switzerland; and at Toronto (1927). In all three places the average



EFFECT OF THE ALTITUDE OF THE OZONE

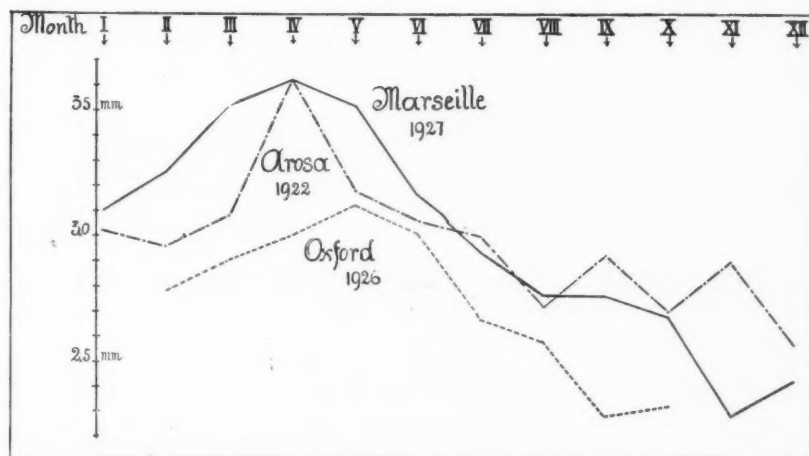
Figure 2: The lower the layer the greater is the variation in length of path of the sunlight from noon to evening. This permits determination of the altitude of the absorbing layer

altitude of the layer was found to be in the neighborhood of 40 kilometers (25 miles). At that altitude the pressure is low, not much more than 1/1000 of the pressure at the earth's surface.

At such an altitude there might exist a gas lighter than oxygen and nitrogen. This, however, proved not to be the case. Raleigh and Fowler, experimenting some time ago with ozone, found that the same dark bands appear as in the sun's spectrum, if the ultra-violet light from an arc is sent through a mixture of ozone and oxygen.

Now ozone is a gas heavier than air; it is a form of concentrated oxygen, "150 percent oxygen," so to speak. It is a peculiar substance, only quite recently obtained in a pure form, explosive when concentrated, of dark blue-black color when liquefied and transformed back to ordinary oxygen when slowly heated. Its occurrence in the high atmosphere explains not only the dark bands in the ultra-violet spectrum, it accounts also for the abrupt end of the sun's spectrum.

CERTAINLY the sun itself sends out more ultra-violet light and a much longer colorband than we observe on earth; but the ozone, as if it were a piece of metal, screens off the farther end. We may measure how much ultra-violet is absorbed by a layer of ozone of one or two or five millimeter thickness, and by studying the bright and the dark bands in the spectrum (Figure 1), we may compare this with the amount that the atmosphere absorbs. The result is that there must be, at about 40 kilometers (25



VARIATION OF OZONE THROUGHOUT THE YEAR

Figure 3: In Marseilles, southern France, it proved possible to make spectroscopic determinations on almost every day of the year. Similar variations have been observed at Mount Wilson Observatory, California. The ozone "burns away" as summer advances

miles) altitude, a layer of ozone equivalent to three millimeters or one eighth of an inch at atmospheric pressure. This is a small amount, and ozone is one of the rarest gases of the atmosphere.

The number of waves of ultra-violet light from the sun which the atmosphere lets through is comparatively small—less than 1 percent of the whole energy—but these waves at the end of the spectrum are in many respects more powerful than the visible ones. They are the rays under which wounds begin to heal, pale cheeks to color. Or, as an English farmer has recently put it, "They are the rays which bring higher market prices for pigs." Even if it were only for the amount of heat

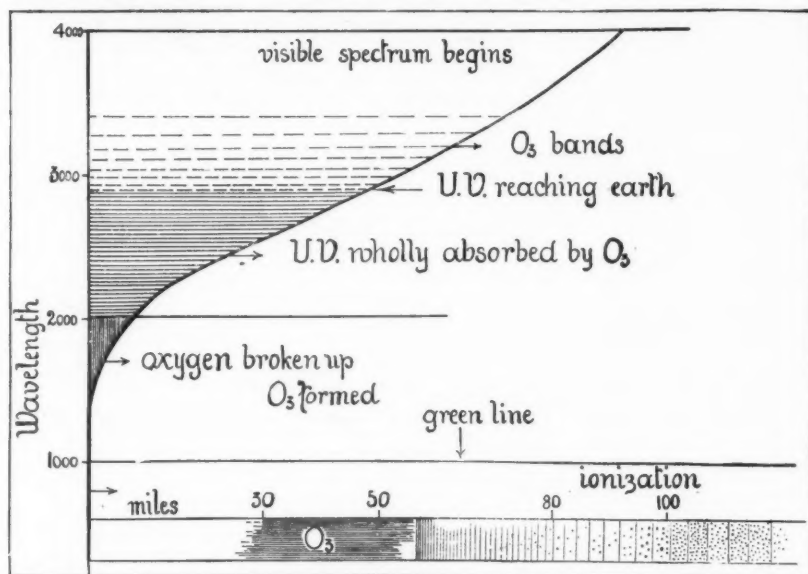
which the earth loses by the absorption of these rays in the atmosphere they would represent a sum of almost 1,000,000 dollars per second. No wonder therefore that in the last few years accurate measurements on the ozone bands have been made, and in some places the quantity of ozone (or of ultra-violet) had been followed from day to day.

The ultra-violet spectrum has been and is being studied in Arosa, Switzerland, at the expense of this famous mountain resort; in the Meteorological Department of Oxford University, England; at the University of Montpellier, France, where the sky is very clear, and many other localities. Other places carry out some work on the total absorption of ultra-violet only. The first years of study have already given some interesting results. In all the places situated in the northern hemisphere there is a marked variation in the course of the year of the amount of ozone present. The thickness of the layer is highest in the beginning of spring and decreases during the summer months, (Figure 3).

TOWARD autumn the atmosphere becomes clearer for the ultra-violet. Probably, as the summer heat increases, the ozone begins to decompose faster than it is formed, as heat has been found to be detrimental to its existence. Another feature is that the altitude varies in the course of the year.

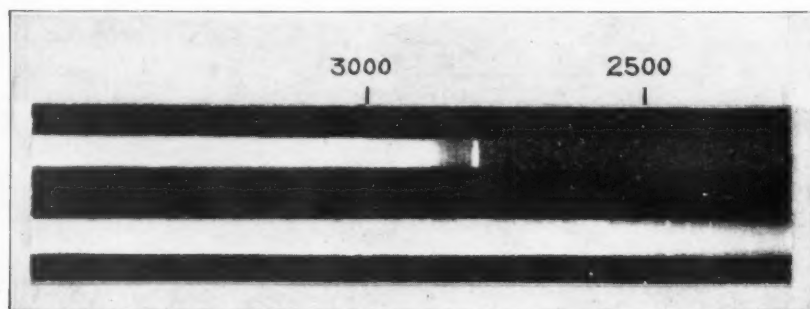
Finally, the amount of ultra-violet varies from place to place, a maximum having been found in Egypt. It will be necessary, however, to make further observations and it is greatly to be desired that more stations should collaborate in different parts of the globe. In Toronto, where I have made a series of observations, the winter months are too cloudy for useful observations.

How is ozone formed in the atmosphere? In the laboratory ozone may be



DISTRIBUTION OF ENERGY IN SUN'S ULTRA-VIOLET

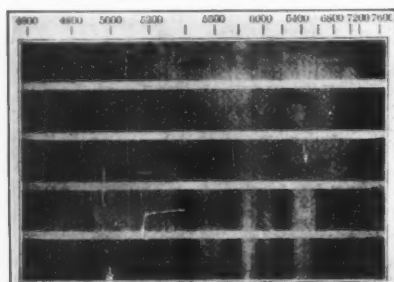
Figure 4: Height above the earth is shown on horizontal scale. Vertical scale gives wavelengths in Angstrom units (A.U.) in the ultra-violet. Wavelengths below 2960 A.U. issue from the sun but do not reach the ground level as longer ones do. At 3900 A.U. the ultra-violet ends and the visible spectrum begins. The distance from left side to the curve represents relative amount of energy which the sun emits at the wavelength chosen. The entire figure shows effect of ultra-violet upon the atmosphere, and is worthy of detailed study



SHOWING HOW OZONE CUTS OFF THE SHORT ULTRA-VIOLET

These two spectrograms of an electric arc were taken through a quartz prism, as glass would exclude the shorter wavelengths of the ultra-violet. In the lower one wavelengths as short as 2200 Angstrom units—much shorter than any in sunlight—are indicated. In the upper one ozone was introduced. It cut off the majority of the shorter wavelengths

prepared in very different ways. Ozone is formed when an electric discharge is sent through oxygen, and is used in this way for the sterilization of drinking water. In the atmosphere we have discharges in the form of the Northern



UNKNOWN DARK BANDS

Spectrograms of light reflected from the planets (top to bottom, moon, Jupiter, Saturn, Mars, Neptune) made at Lowell Observatory by Slipher. The moon's is simply reflected sunlight, as the moon has no atmosphere. The minor planets give a similar spectrum, but the other planets hold back narrow bands of light, particularly in the infra-red (off the scale, to right) and in the visible spectrum (7700 to 3900 A.U.). The only substance known which shows the same absorption in the visible spectrum is ozone. Note absorption bands near 5400, 5750, 6100, 6200

Lights, causing irregular variations, but it is not known how far their influence extends toward the south. Ozone is also formed when ultra-violet light from a mercury arc or from a spark is sent through oxygen, and part of the action of the ultra-violet may actually be due to ozone. In the high atmosphere there is available the ultra-violet radiation from the sun. Although its energy is small, less than 1 percent of the total solar energy stream, this limited part of the solar spectrum brings about more effects in the atmosphere than perhaps the whole remaining portion, (Figure 4).

The farthest end of the spectrum ionizes the air, that is, breaks up the air into positively or negatively charged particles. A conducting layer is formed which reflects and bends radio waves. The next portion of light waves breaks up the oxygen, or better, breaks up one part of the ordinary molecular oxygen into two parts of

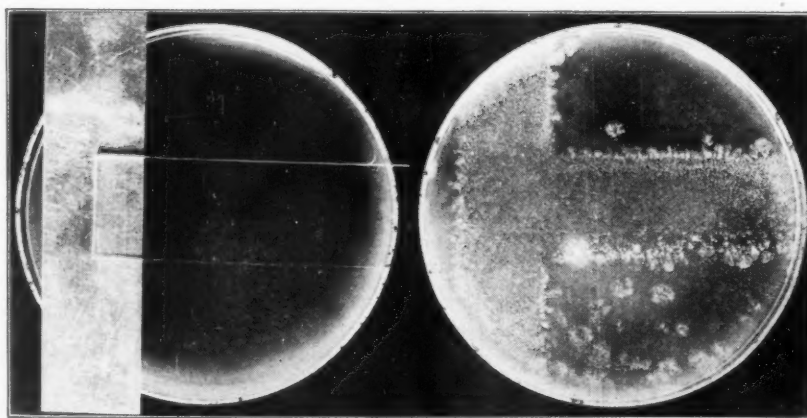
atomic and more active oxygen, some of it being perhaps phosphorescent or made phosphorescent by the ultra-violet light. This region, extending from about 50 miles altitude to 120 miles or more, sends out a faint green light during the night. Not before 1925 was the same kind of light produced on earth (see "The Mystery of the Green Line," McLennan, SCIENTIFIC AMERICAN, January, 1929), and in 1927 I was able to show that this peculiar light was a quite unusual "forbidden" ray, which can be sent out when chemical reactions take place in a diluted gas.

Toward the lower altitudes of 30 and 40 miles, oxygen atoms become scarce, and when they come in close contact with the oxygen molecules, ozone or O_3 , really an oxygen triplet, may be formed. The total number of ultra-violet waves which are able to

split up the molecular oxygen is limited, so that a measurable increase or decrease in ozone requires a fairly long time. It would take a day to double the amount of ozone in the air.

The ozone bank at 30 miles altitude absorbs a considerable portion of ultra-violet (Figure 4), especially that part of it beyond the spectrum of natural sunlight which has proved injurious to our body and harmful to the life of plants. Its only action is now to heat up the ozone which keeps it back. Thus a warm layer of air is formed high up in the atmosphere, which helps to support the heavier ozone molecules. Thus we find that the dark and bright bands in the sun's ultra-violet are the same as those observed with ozone in the laboratory. If the temperature of the ozone layer were to become very low, the bands would be much narrower. The smallest portion of the powerful ultra-violet radiation penetrates down to the earth to our greatest benefit.

ON the moon or on planets which lack oxygen, the surface is exposed to the entire ultra-violet, even to the harmful short rays which exert their destructive action freely. On the major planets, on the other hand, where oxygen and water seem abundant, ozone will again be formed, and as the temperature is low enough it will perhaps even condense. The spectra of these planets have new dark bands in the green, in regions where the visible ozone absorption is strongest. The significance of this is evident.

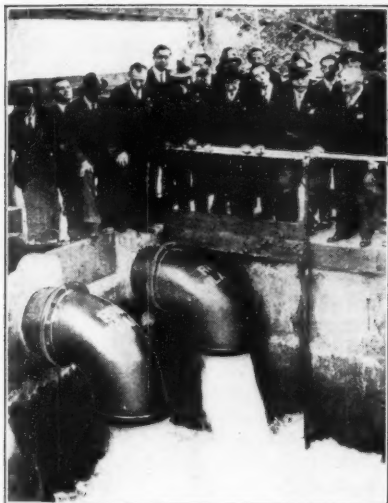


Courtesy of Journal of Agricultural Research (Washington, D.C.)

CAN ULTRA-VIOLET RAYS DESTROY DISEASE GERMS IN OUR BODIES?

This experiment demonstrates the extremely low penetrative power of ultra-violet rays. At left is a dish containing invisible cultures of microscopic fungi that attack citrus fruits. Over the dish a strip of metal and a piece of glass have been laid and the whole exposed to strong ultra-violet rays from a special lamp. Then the dish was put away for the invisible cultures to multiply and become visible. Three days later we have the picture at the right. The metal strip obviously protected the cultures for they are now thriving and visible where it was. The thin glass shut off the destructive ultra-violet rays about as well as the metal. Elsewhere there are occasional patches of cultures which were not killed, merely because the tiny spores were able to screen off the spores lying beneath them—so non-penetrative are the ultra-violet rays. From research performed by Harry R. Fulton (Bureau of Plant Industry) and W. W. Coblentz (Bureau of Standards). If ultra-violet rays are stopped by a tiny spore, or even a bacterium, what becomes of claims that certain ultra-violet lamps can "destroy disease germs" within the body, merely because ultra-violet rays do destroy germs—if they strike them? It is true, a patient's blood may acquire added power to kill germs, as a result of effects picked up by it from the skin after exposure to ultra-violet rays, but this power may actually be reduced to less than normal by over-exposure. Thus the correct exposure for each patient is a difficult matter for the specialist to arrive at—not to speak of the layman. (This illustration is inserted by the editor.)

Pumps Disclose Lake Nemi's Secrets



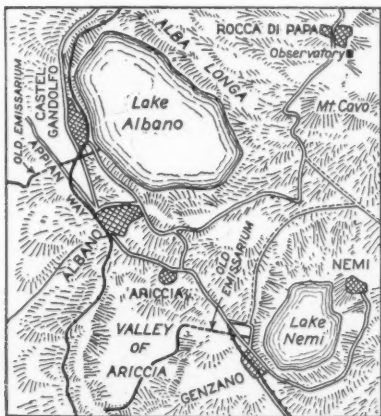
EMPTYING A LAKE

This is a big proposition even though the beautiful crater lake is only $3\frac{1}{2}$ miles in circumference. It is 110 feet deep



THE INTAKE PIPES

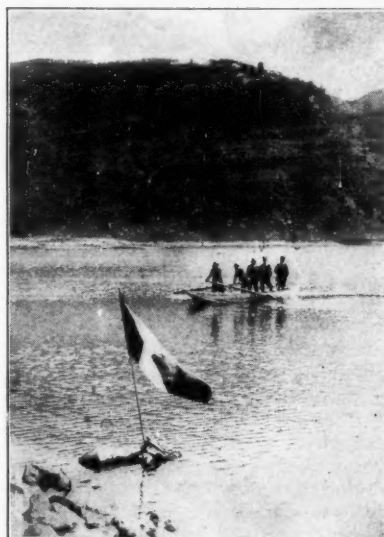
Huge centrifugal pumps are slowly but surely reducing the level of Lake Nemi



NINETEEN miles southeast of Rome, high in the Alban Mountains, are lakes Albano and Nemi, each drained by ancient Roman tunnels. They are constantly referred to by classical authors. Lake Nemi was called the "Mirror of Diana." This gorgeous little lake is best known as a retreat for the altogether disreputable Emperor Caligula who caused magnificent galleys to be floated near the shore. Lake Nemi is now being drained by electrically-driven centrifugal pumps and the bottom will soon be disclosed. This is the most romantic archeological adventure in the annals of this repository of ancient treasures.

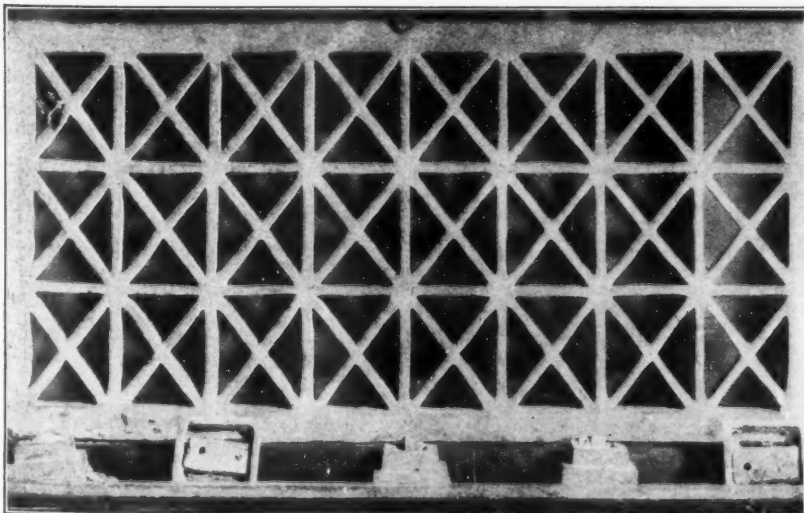
MAP OF THE ALBAN LAKES

High up in the Alban Mountains are lakes Albano and Nemi, noted classical sites



POLICEMEN OF THE LAKE

These soldiers are keeping the curious spectators from coming too close to the bank where important finds are imminent



A BRONZE BALUSTRADE

Divers brought up this bronze balustrade in 1905. The 1900-year old galleys gave up much bronze work and the draining of the lake may bring to light important objects



BRONZE LION HEAD

If this was brought up by a diver, what will the harvest be when the lake is drained and the galleys exposed to view?

It Is Safe to Fly

High Safety Factors in Construction, and Efficient Personnel, Contribute Materially to Aviation Advancement

By LADY MARY HEATH

LIFE has become such a rush—there is so much to be done and crowded into each day's 24 hours—that we have become a nation of headline readers. Herein lies a tragedy. We see a headline, "Another Air Crash," and instead of reading through the story, we instantly put the accident at the door of general aviation. We fail to realize that accidents most often occur in experimental flights, in stunt flights, or perhaps because some carefree pilot has been practicing the arts of warfare in a high-powered machine. Even in the military service, where one would expect most of the flying accidents, they are getting fewer and fewer. For example, there have been one third less army accidents in the past year than during the two previous years.

THERE are three main factors in aviation today: ease, economy, and safety. The ease of flying is shown by the wonderful record of the British light airplane clubs which graduate hundreds of pilots, men and women, with an insured minimum of 10 hours instruction. In the first half of 1928, these pilots made 45,000 flights without injury to anyone. On all of these flights, the machine, the instructor, and everybody who was on the ground over which these airplanes flew, were covered by insurance.

Considering the economy of flying, we find that, because no permanent roadway has to be put down, such as for motor cars or train traffic, the long-distance airline has to support only the cost of operation of its terminal

airport. For any distance greater than 500 miles, which takes about five hours to fly, we find air transport the cheapest as well as the least tiring method of traveling, or of sending one's most valuable freight or mail. It will come as a surprise to most people to learn that the insurance rate for that most precious commodity, gold, is one third less by air than it is by what we call "surface transport." But this speed, comfort, and pleasure, are useless unless we can make flying safe for everybody.

FAR more so than in Europe, the American continent is going to develop its airlines. The Stout Air Lines claim to be the possessors of the lowest insurance premium per passenger-mile, of any airline in the world, although the amounts offered in case of injury are by no means the smallest.

When an airplane is doing what it is built to do—flying—there are four things to be looked after, if we are to make the word aviation synonymous with safety; these are the machine, the engine, the pilot, and the passengers. The same reasoning applies equally to the tiny two-seater, and the great four-engine airliner.

First of all, we want an airplane that is absolutely sound in all respects. Its flying qualities and its construction must be good. How it behaves in the air depends on the designer long before the ship ever comes out on the flying field.

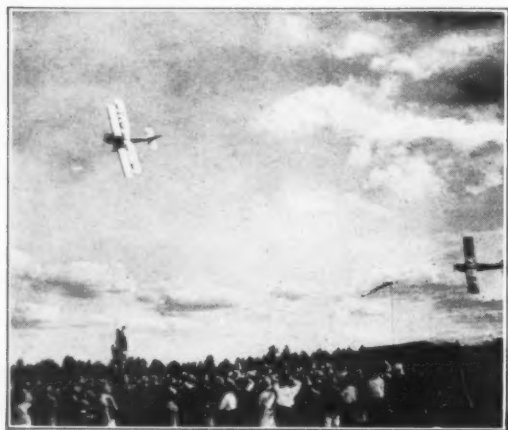
The well designed airplane will practically fly itself. Madame Florman, of a famous Swedish construc-

tion company, and herself a pilot, told me the other day of a tour she took around Europe with her husband and three friends. In good weather they would set their big Junkers on its course and on even keel. Then they would make up a foursome of bridge in the cabin, leaving only one person in the pilot's cockpit to watch for any alteration of drift or possible changes in external or internal conditions.

But all flying is not fair-weather flying. Passengers are not taken on the airlines if the weather conditions are such that flying will be dangerous or uncomfortable. The ambition of all those in the industry is to make people want to fly again. Nevertheless, on a long flight, bad conditions sometimes arise, and the machine must be so air-worthy that it will weather any storm that may occur.

On the airlines in Great Britain, the government insists that machines have a minimum factor of safety of seven, which means that the machine must be seven times as strong as it need be to meet normal conditions. Commercial machines need not be thrown about like fighting ships of the army and navy, but when I say that the fast loop, one of the most common maneuvers, uses the factor of safety only up to three, you will realize what a huge margin of safety a factor of seven gives.

AS a pilot of little sport planes, I have often grumbled at the high price of my mount. But when I have struck bad weather over the Alps, or in tearing, sand-bearing storms in the

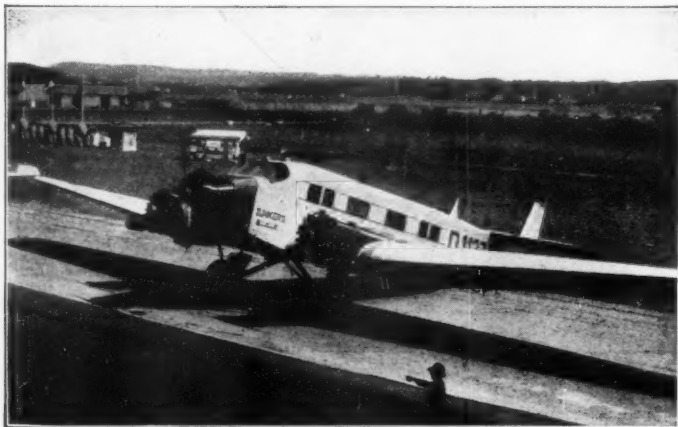


RACING CAN BE DANGEROUS

Many aviation fatalities are due to racing or stunting with inferior airplanes or by inexperienced pilots

MULTI-ENGINED FOR SAFETY

Large airplanes, carrying a crew and passengers, are usually equipped with two or three engines. They can fly with any one engine stopped



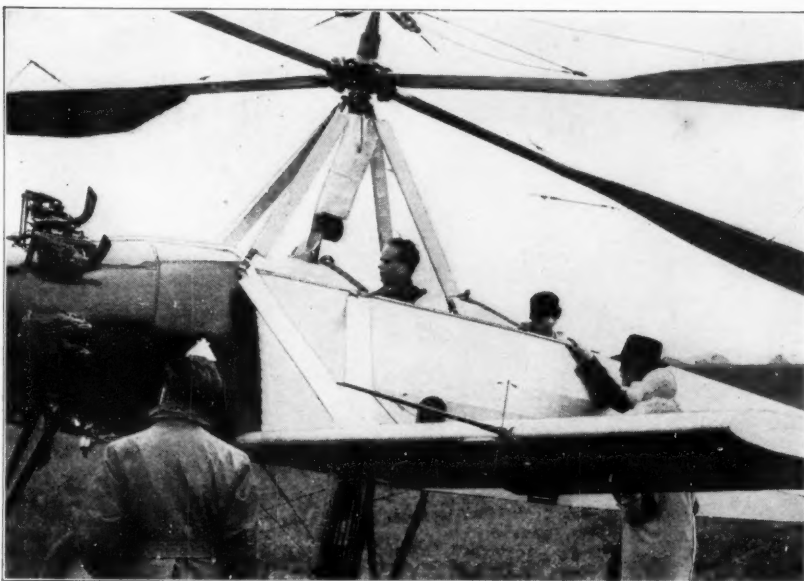
deserts of Africa, and have been tossed about like a feather until my body was bruised and blue from being thrown from side to side of my cockpit, I have thanked the "powers that be" for making me pay extra for that large factor of safety.

It is a wonderful experience to go through one of the best American airplane factories which produce machines that have a factor of safety as high as 10, and to see all the materials checked and examined before they are made into the different parts. Then one sees each tiny part checked and stamped before the plane is assembled. Another examination is given before the test pilot steps into the machine.

There are various devices which are being attached to ordinary machines to make them secure and more reliable. The most interesting of these today is the Handley-Page automatic slot.

THIS contrivance saves the machine from the spinning nose dive that has so often ended fatally. The slot is a very simple thing, structurally. It is composed of a strip of metal along the front edge of the wings, fitting snugly to the curve. When the machine slows up too much, owing to any cause—usually an error of judgment of the pilot—this strip of metal automatically swings out on its hinges, and the slot between it and the wing re-creates over the surface of the wing the flow of air that keeps the ship balanced and controllable. Then if the airplane does come down, it descends on an even keel like an elevator, instead of diving downwards with great discomfort and probably danger to those inside.

Another device for avoiding the "stall" is the Bramson anti-stall gear. This merely jerks the control lever of the airplane sharply whenever the



SENOR JUAN DE LA CIERVA AND THE AUTHOR

They are shown here in the cockpits of de la Cierva's "flying windmill," or Autogyro. Ships of this type, when perfected, may contribute in great measure to increased aviation safety

minimum flying speed is approached and reminds the pilot that by some means or another he must gain more speed to keep his ship afloat in the ocean of the air.

Another interesting invention from the point of view of safety is the La Cierva Autogyro, in which four freely rotating blades, constituting a giant horizontal windmill, act as a substitute for the conventional fixed wings. The Autogyro can land on a very steep path, very slowly, and stops within some 50 feet after landing. It has considerable promise as a machine for the private owner.

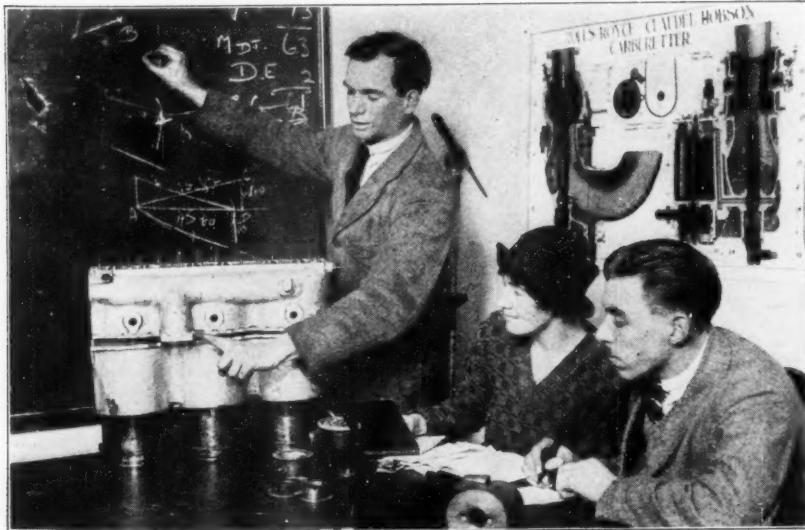
I have had the pleasure of flying with these three devices which attack problems of flight in different ways;

but when I fly as a passenger I prefer to have the added assurance that the pilot is so fine that he will not need any of them.

To add to the safety of the machine, external fittings are very often added. One notices the familiar fire extinguisher, although it is practically never needed. And the parachute, although its presence is consoling, is seldom needed on the big commercial airlines. Its chief function is for the test pilot, that brave man who must take up a new airplane every day or two to find out what it will do under all circumstances of normal and abnormal flight.

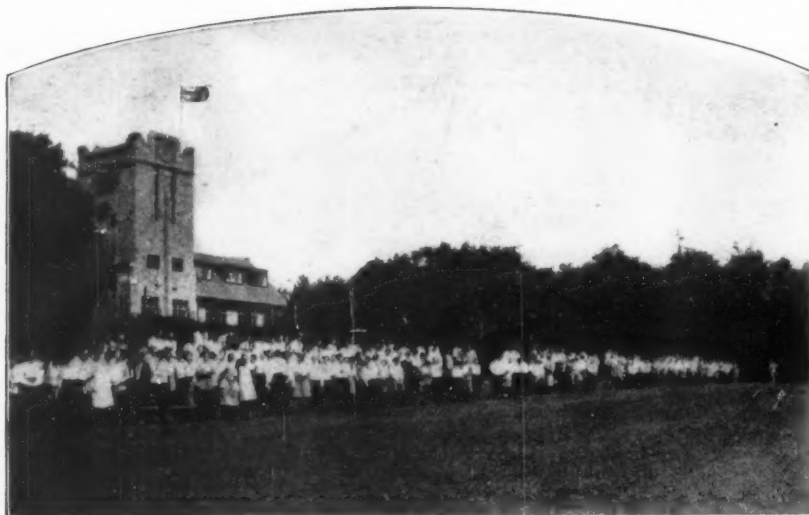
SOME of the airlines refuse to carry parachutes because they might remind the passengers of danger. But who is perturbed by the life boats which stand on the top deck of every ocean going liner?

No matter how perfectly any piece of mechanism is made it is subject to wear and tear. For this reason a most elaborate system of ground examination is necessary for the safety of passengers. Every day a qualified mechanic goes over the ship in detail and signs a report. Then an engine man does the same thing for the engine. The pilot must then take the machine into the air to test it and when he comes down, must countersign the report before a single fare-paying passenger is taken up. Once a year each airplane is taken apart, and even the most minute parts are examined and replaced if worn. The same care is given the engine but the examinations are more frequent. The engine receives "top overhaul" after every 150 hours in the air and a complete



KNOWLEDGE IS SAFETY

A good pilot must have a thorough knowledge of aviation from all angles. Well organized schools of instruction make it possible for anyone to obtain this necessary information



GREAT EXCITEMENT

This group is composed of students of Shelbourne School, Dorset, England, who turned out to meet Lady Heath when she landed on their play field to deliver a lecture on aviation

overhaul after every 300 hours of flying.

The reliability of the engine itself is in the hands of the big engine construction companies. The engines that carried the dozens of machines through the National Air Races last year, were guarded by well-designed cowling for protection from the wearing sands of the desert, or the insidious water vapor of humid patches of the atmosphere. When we think of those gallant engines that took Lindbergh, Miss Earhart, Chamberlin, Koehl and his companions, Alcock and Brown, and Reed, across the hungry stretches of the Atlantic, we realize that engine reliability is assured.

WHEN Great Britain, at my request, asked that the international law be changed to permit women to have commercial flying licenses, they wanted to set a standard of feminine efficiency. We brought half a dozen of our women Olympic athletes to our medical board for careful examination. It is the same with the male pilots. Olympic standards are used as the basis of selection of every air-mail pilot and every pilot who has the lives of passengers in his hands.

The preliminary examination takes hours and hours; sight, hearing, sensitivity, health, habits—everything is taken into consideration, even one's family history "unto the third or fourth generation." Even that is not enough. The pilot must come back every six months to have his license renewed, so that it will be known if he has fallen from the high standard.

Besides his (or her) fine physique, the commercial air-transport pilot must have a veritable encyclopedia of knowledge to fall back on if anything should go wrong. He will not get his license until he knows enough about

meteorology to be a weather prophet, and he must know nearly as much about the machine and the engine as the constructors do. He must have learned all the laws of navigation and the etiquette of the air and must already have a long record of safe flying before the insurance companies will permit the airlines to employ him.

There are several other factors which should be considered. It is a waste of time and money to build the most beautiful machines in the world unless we have good landing fields. The split axle of the modern machine, which will not trip over any obstacle, is useless if the landing surface is so bad that a wheel will catch and stick in a rut. It is imperative that we have many landing fields with good surfaces. Foot brakes to stop planes in a short distance are now supplied

on most machines; but large surfaces, at least 1000 yards in every direction, are needed to keep up the high standard of safety we are attaining.

THERE should be landing grounds between big flying fields. To my mind, the most wonderful system of air lines in the world is that which is operating quietly, unobtrusively, and without accidents, year after year, in the Belgian Congo, traversing thousands of miles of jungles, lakes, and mountains. They have built emergency landing fields every 20 miles. Admittedly, this is expensive, but to save one human life should justify the expenditure of millions of dollars.

The air-mail pilots of America have a wonderful system of light and radio beacons to guide them at night and through all kinds of weather. The night-flying passenger services of other countries have these too. Thousands of scientists are working on such problems as fog dispersion, fog-piercing lights, and directional wireless.

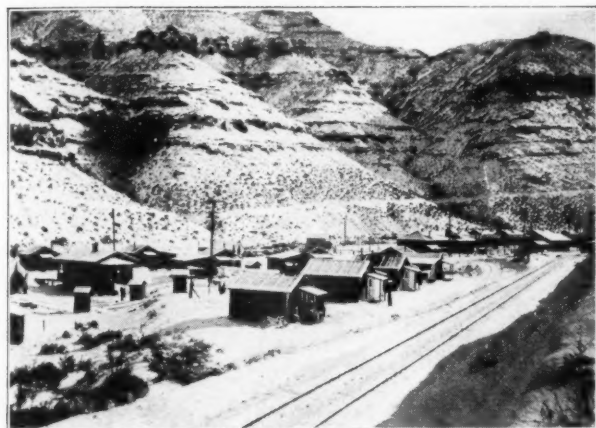
Excellent maps have been especially prepared to show the pilot, at a glance, the salient topographical features of the locality over which he is flying. Back of this map service there is a continental and world-wide weather bureau, giving out reports for the guidance of every pilot, amateur or professional, as he goes into the air.

Today, America leads in aviation, and to keep that lead, all her citizens must work together for the good of the great industry that has grown out of the successful experience of two of her sons 25 years ago. America must help international aviation, too, for she has given something to the world that is greater than national supremacy in aviation—an industry which is making for a happier, a more peaceful, and a safer world.



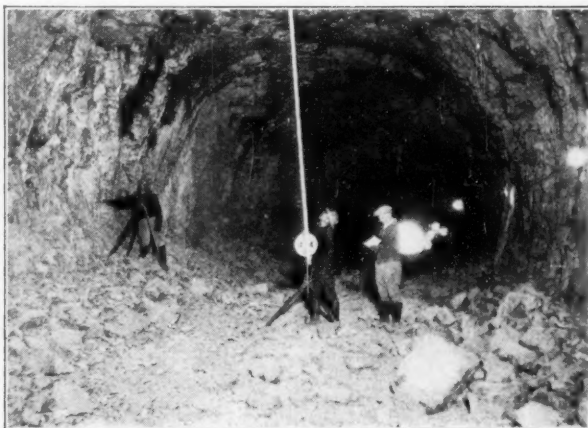
DANGEROUS FLYING COUNTRY

Aviation traffic over the Alps requires a complete weather reporting service. This has been perfected by the Austrian, Swiss, and Italian governments to such an extent that their airway lines are said to have a much better record of safety than their railroads



WORK ON THE DAM HAS BEGUN

Workmen's camp at the damsite. As the work progresses and work on the dam itself is started, this camp will grow rapidly



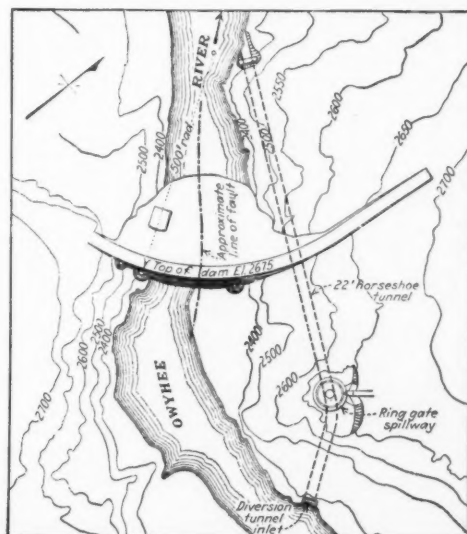
CUT THROUGH SOLID ROCK

The river diversion tunnel through which the river will be diverted during construction and which will be the spillway later

The World's Highest Dam for Irrigation

WHAT will be the world's highest dam at the time of its completion is being built by the Bureau of Reclamation at a point on the Owyhee River in Oregon that was once used as a rendezvous by cattle rustlers. Known as the Owyhee Dam, it is the principal storage reservoir for the Owyhee reclamation project and its impounded waters will be used for the irrigation of 120,000 acres in Idaho and Oregon, and for the incidental generation of electrical power.

The dam will be of concrete and of combined arch and gravity type; 405 feet high at its highest point; and will have a total capacity of 1,120,000 acre-feet. It is particularly significant that, in the planning of this dam, extensive geological and engineering investigations preceded approval of the site and designs. According to Mr. J. L. Savage, of the Bureau, the design of the structure called for the development of a number of features new in dam construction. While spillways through solid rock around the end of dams are not new, this feature



Courtesy Engineering News-Record

THE DAMSITE

Drawing, with contours, to show dam, spillway through rock, and rugged nature of the country where dam is being built



IN SOME RESPECTS A SIMILAR DAM: THE SHOSHONE DAM

The spillway of this dam was cut through solid rock, as were also the penstocks to the power house. This dam in Wyoming was built for power generation and irrigation

is of special interest in the Owyhee Dam. It consists of a 22-foot tunnel, concrete lined and 1005 feet long. During construction, it will divert the river water but later will be connected with the vertical intake shaft which stands 240 feet high. The top of this spillway is a funnel lip on which is to be installed a radically new type of ring gate, this latter being a circular spillway controlled by a ring gate.

Provision has been made in the design of the dam for the future installation of a power plant to utilize the flow of prior right water, that is, water on which rights for irrigation purposes are held. Two six-foot conduits are provided, each to be controlled by a five by six-foot cast iron emergency gate operated by oil pressure. An innovation in dam practice is the installation of elevators in the dam itself for carrying up supplies and heavy repair parts.



THE STUDENTS STAGE A PLAY

This scene shows the opening of the first act of "The Fan." The scenery, properties, and costumes were all made by the students in the drama course, who also act various parts

The Stage Goes to School

All Phases of Stage-craft are Taught in New Course in Drama

By CHESTER M. WALLACE

Professor of Dramatic Art, Carnegie Institute of Technology

THE Drama Department of the Carnegie Institute of Technology is organized on the principles of a professional repertory company. During eight months of school there are fifteen regular productions, or about one every other week. The average "run" of a show is ten performances. One can readily see the high degree of organization required, and the skill needed by the students, who do all the construction, painting, lighting, and stage-

managing on these dramatic productions. To make this possible the students who do the stage work must have a thorough knowledge of the principles of production, and of equipment on hand in applying these principles.

There are two purposes in such organization: (1) to put on the scheduled shows as professionally and efficiently as possible, and (2) to instruct the students in the principles and craft of stage work. The

stage-craft class furnishes a link between these two points of practice and theory.

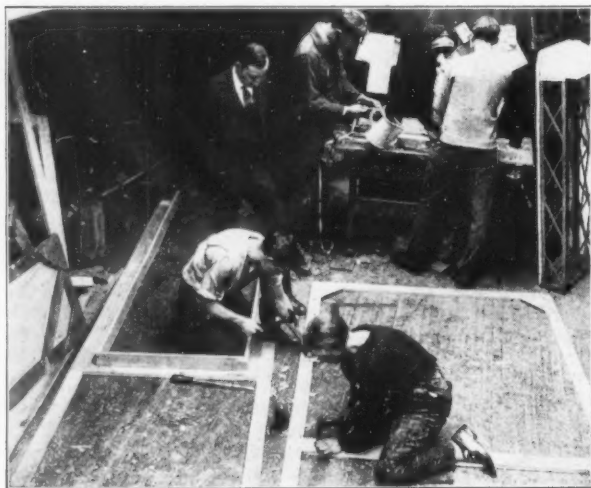
The freshman class in elementary stage craft receives one lecture a week, coupled with the crew work in the theater, which occupies about twelve hours. Each show is brought up before the class several days before the actual work on it commences. Its problems are discussed and analyzed, and often student designs are accepted and put into practice. Thus the students are prepared to make the most of the equipment at hand, knowing that every hinge and corner-block has its purpose.

The lecture course consists of a series of 32 talks on stage-craft, divided roughly into eight divisions. The first few cover construction and equipment—the names and uses of the different units of settings: flats, drops, platforms, steps, pillars, runways, arches, and bridges—the posts



A PAINT FRAME

The students are taught the art of scene painting, a subject not easily learned



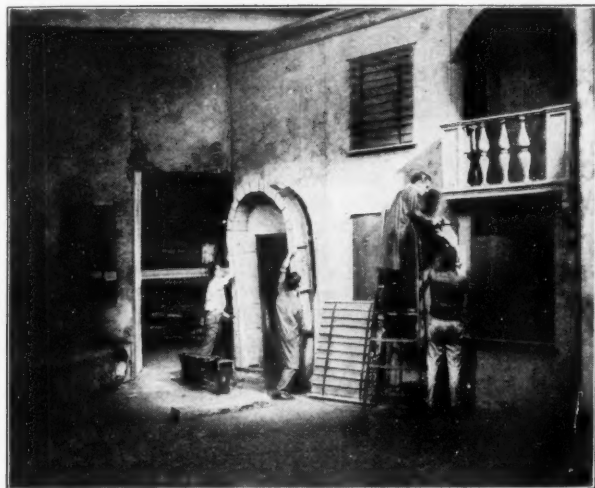
STAGE CARPENTERS

Practically all scenes call for wooden frames. Here the students are being instructed in the proper manner of making these parts



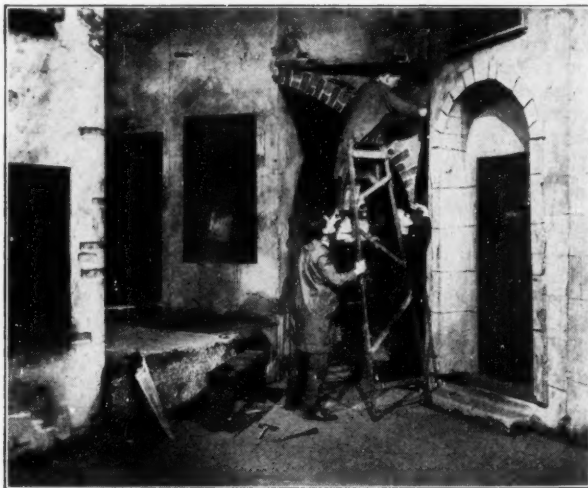
PROPERTY MAKING

Every play requires a number of "props" or various objects to give local color. Each must be carefully designed for proper effect



SETTING A SCENE

In the center, two students are shown placing an entrance arch, while to the right, two more are installing a "property" balcony



BUILDING AN ARCH

Everything on the stage must be so made that it can be erected quickly and quietly, and as rapidly "struck" for transportation

of a stage crew and duties of each man, followed by detailed discussions of construction and fittings, stresses, carriage of weights in batten frameworks, and the means of placing, shifting, and storing the various units so as to facilitate quick and efficient changes of scenery. Next come the theories of design as applied in stage craft, their purposes and their uses. Types of permanent and unit sets are discussed—changeable pylons and step-units, draperies and drops, and the advantages and fallacies of each type. After this come the lectures and demonstrations of the mixing of scene paints for different purposes, use of elementary tones in solid and combined colors and the effect of several of the most commonly used tints in lighting on the painted scenery. Some of the most interesting lectures and demonstrations in the course are those which deal with lighting. These cover all the different types of light-units used on the regular stage of a large theater.

One of the bugbears of nearly every so-called "technical show" when produced, lies in the making of proper off-stage noises. The stage-craft course includes sound effects which fall to the average crew man such as chimes, bells, hoof-beats, iron and wooden gates opened and closed, footsteps, thunder, rain, hail, wind, explosions, cannonades, and off-stage shots. In every production where off-stage noises are heard, and there is scarcely a show that does not have at least a door-slam in it, the crew man assigned to that particular task must take his cue either from the property or the stage manager, often with split-second accuracy, for an off-stage auto wreck coming a second too soon might easily wreck the entire play.

The making of properties is another item which requires class instruction. Curtains, candlesticks, flowers, food, all can be, and often are "faked" as much from the point of economy as desirability. It is hard to realize that the luscious

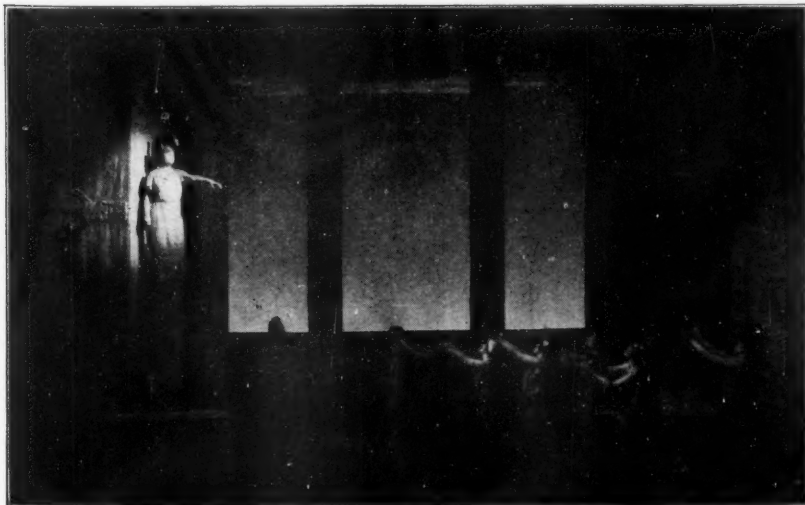
turkey in the dinner scene of a certain play is only papier-maché stuffed with sliced apple. The actor who selects a piece from a box of candy has to be careful to get the one real chocolate that is placed there for his benefit, and not one of the painted stones which fill the rest of the box.

In addition to, and during these lectures, come the lectures and class



◀ ▲ SECRET ENTRANCE

Above: A player passing from back-stage through a door to the top of a broken pillar on the stage. Her entrance is preceded by a flash and smoke which conceals the operation of the door. Left: The final effect of the set on the stage



talks on current products in the department. The layout of each production is brought before the class with floor plans, working drawings, and models. The students are taught how to read the blueprints and how to make them, so that the crew goes into the actual building of each show with an idea of the purpose and means of each piece of scenery and effect.

Supplementing the freshman work in stage craft are the upper-class options of scene painting, lighting, and model-making. The student taking scene painting is first instructed in the mixing of paint, a very complex process since unlike oils or house paint, every bucket of scene paint for every different purpose is mixed to a different consistency, the amount of glue, base, color, and water varying according to use.

Next the student is taught different brush finishes—ways of covering space on canvas, lumber, or wall board to get the most surface on each for the amount of paint used, and the amount of paint used to cover a given number of square feet of surface. Then one goes on to study the various finishes: sponging, stippling, cross-hatching and combining. Next comes the art of painting to imitate stone or wood, followed by lessons in graining, paneling, and painting high-lights and shadows so as to render under given lights the effect of relief and form on flat surfaces. The final and more advanced step is that which leads to the painting of foliage (tropical, northern, or temperate), landscapes (winter or summer), cycloramas (sky effects with broken colors on a flat surface) and false perspective, to simulate distance and depth, which is so often wasted in the actual theater of to-day.

THE course in electricity and lighting begins with a study of electrical conductors, open and closed circuits, amperage, wattage, and voltage, and the reading of measurements of electricity. This goes on to the study of simple resistance and reactance dimmers, and remote controls. The



WARDROBE MISTRESS

Wear and tear on costumes is such that the sewing machine and pressing iron are always in demand

student is taught the use of the switch-board and plugging systems.

From this the student goes into simple intensities of light, and night and day effects. Then comes the use of color mediums, cones and diffusions, and the effect of different color filters on the range of colors in costumes, make-up, and scene paint, lighting for mood, character, and movement in relation to the play at hand, color contrasts used for illusions of distance, height, or depth, and lighting a setting and the actor in relation to the setting and to his particular needs in expression.

The students in model-making construct models to scale from the designs and working drawings of the plays as they go into production. Special instruction is given on materials and the use of diminutive perspective. In this way each show is first built in miniature and special problems of lighting and painting are studied out on the model before being tried on the stage in normal size.

Freshmen in the Drama Department receive three hours a week in-

struction in make-up. The men and the women are taken separately, since the problems encountered by each are entirely different. Each student receives individual instruction and criticism, and is taught how to make the most of his own facial and physical peculiarities in the expression of character through appearance. The group is assigned a different problem every week. These problems include old age, juvenile, Oriental, negro, stylized, and every type of make-up that the repertory actor is apt to be required to use.

THREE or four classes every semester are spent in the dressing and use of wigs and beards, and in lectures on the various period styles of beards, mustaches, and hair-dressing, such as Elizabethan, Norman, Cavalier, and Victorian modes. During productions where the freshmen are cast as supers, such as courtiers, soldiers, crowds, and so on, the individual types and make-ups are worked out, and the students are allowed to try their make-ups under the various colors of lights before ever going on stage. When a freshman has completed this course, he is ready, as far as appearance is concerned, for any of the many different parts he will play in the three years to follow. No regular classes in make-up are given after the first year, but the students continue to develop skill because of the many and varied make-ups they are called upon to use in a repertory company.

Among the two hundred and fifty plays produced by the department during the past 13 years have been 14 of Shakespeare's plays and such classics as "Iphigenia in Tauris," "The Rivals," "She Stoops to Conquer," "School for Scandal," and several of the somber Ibsen plays. Modern examples have not been neglected. About eight performances are usually given.



MAKE-UP INSTRUCTION

Cold cream, grease paint, and rouge have to be applied properly. Make-up is truly an art, and is a foundation stone of the drama



INDIVIDUAL MAKE UP

The students are allowed the use of make-up tables such as they will find in regular theaters after they finish their school course

Underground Arteries for Oil and Gas

Pipelines Hundreds of Miles in Length Surmount Natural Barriers

Transporting Fuel to Refineries and Distant Cities

By HENRY W. HOUGH

HE stayed not for brake and he stopped not for stone, he swam the Eske river where ford there was none." Apparently something of the spirit of the gallant young Lochinvar inspires the modern engineer, who deftly draws a straight line between widely separated points on a map of the United States and calls it the right-of-way for a huge pipeline to transport oil or natural gas from the producing area to a distant refinery or city. Over mountains, down rocky precipices, through slimy swamps, across rolling prairies, and beneath turbulent mountain streams or wide rivers, the pipeline transports its fluid cargo without interruption or delay.

IN the early days of the petroleum industry, teamsters transported the "black gold" in tank-wagons; now, with the aid of powerful pumps, the oil surges through huge, black arteries of iron or steel, hundreds of miles in length. In all of our great oil and gas pipeline systems of today, we see the 20th Century development of the bamboo pipe used in China more than 2000 years ago to carry natural gas for lighting.

More than 80,000 miles of main and gathering oil lines now provide a great underground transportation system between oil fields in various parts of the country and ship terminals, railway loading racks, and refineries.

The longest of the oil trunk lines extends from Texas to Bayonne, New Jersey, a distance of nearly 1700 miles. Many large cities, hundreds of miles from the source of supply, are receiving natural gas through pipelines from 16 to 24 inches in diameter, and a 1200-

mile pipeline project now under construction will provide natural gas from the Louisiana fields to Birmingham, Atlanta, Chattanooga, and other southern cities.

The mileage of main natural gas lines in the United States almost equals our 81,000 miles of manufactured gas lines. This is particularly significant in view of the fact that most of the larger natural gas projects have been built within the past two or three years, while the manufactured gas lines have been extended gradually since the first American coal-gas plant was built in Baltimore in 1812.

INDUSTRY keeps its eye on the clock—or the calendar—and the keynote speech of every pipeline engineer is, "Rush it!" Some time ago, when we watched the husky crews of workmen swing into action on circus-day, quickly transforming a trainload of poles, canvas, wagons, and animals into a glamorous spectacle fit to delight the hearts of the town's future presidents, we were willing to admit that human efficiency had about reached perfection. But modern industry sets a new standard for speed in construction. Recently a 30 million dollar pipeline project, nearly 400 miles in length, was built, tested, and pronounced ready for service within 90 days after starting construction.

As soon as the right-of-way has been surveyed, and satis-



Photo courtesy Ford, Bacon & Davis Inc.

DOWN A ROCKY CANYON

This pipeline trench was prepared for a 24-inch pipe which transports natural gas 375 miles



Photo courtesy Ford, Bacon & Davis, Inc.

OVER THE HILLS AND FAR AWAY

Hundreds of miles of gently sloping hills and prairies of the west provide a comparatively good right-of-way for the pipelines

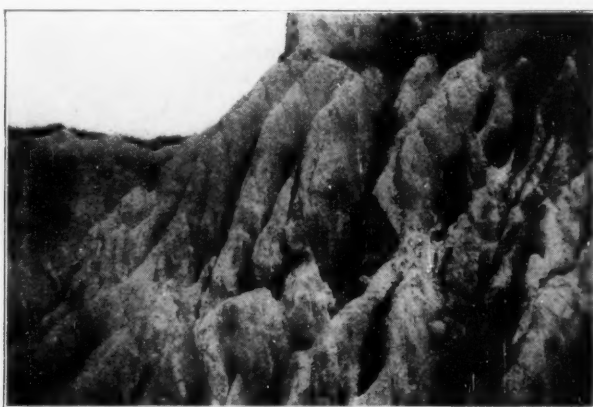


Photo courtesy J. W. Richards & Son

ERASING A MOUNTAIN WITH WIND AND RAIN

An example of severe erosion. This picture was taken in Mississippi, during a soil corrosion survey for a 900-mile gas pipeline



PREPARING A PIPELINE TRENCH WITH A DITCHING MACHINE

Several miles of trench can be prepared in a day with one of these powerful ditching machines. In such places as this the progress is rapid, but in many places the trench must be dug by hand

factory arrangements have been made with the owners of the land through which a proposed pipeline is to run, a survey is made to determine the intensity of sub-soil corrosion that must be expected all along the line. If the pipe is not adequately protected, in corrosive soil, it will soon be destroyed by rust. The right-of-way crew then clears the ground of any trees, boulders, or undergrowth that might be in the way. Ditching machines prepare the trench, usually deep enough to leave two feet of "fill" over the pipe when it is in place. Several crews of workmen with trucks or wagons begin "stringing" the pipe parallel with the trench. Each of these tasks presents a variety of problems, and specially trained crews are used for each phase of the work.

EXPERT welders then connect the various sections of pipe, or, in some cases, the sections are joined together with couplings. Both oxy-acetylene and electric welding methods are used extensively, but the recent trend has been toward electric welding. When in service the pipe has a tendency to expand and contract, and for this reason expansion joints and elastic couplings are usually provided. Sometimes the pipe is "snaked" from side to side on the bottom of the trench to accommodate the strain when the pipe contracts.

After the pipe is welded or coupled, each joint is inspected, and the necessary protective coating is applied. Usually the coating is a hot, thick layer of asphaltic or coal-tar-pitch material, and must be permitted to cool and harden before the pipe is lowered into the trench. When the pipe is finally in place, the backfilling gang replaces the dirt extracted by the ditcher; in most cases this is done

mechanically, using a small tractor equipped with a swinging boom and scraper. The "damage man" then restores any fences that have been temporarily removed, repairs ditches or tiling, and seeks to pacify irate farmers in case a tree, road, or other personal property has been damaged.

During the construction of an oil pipeline, pumping stations are installed about every 40 miles. Compressor or "booster" stations are provided about every 100 miles on a natural gas line, to give the gas less volume and higher pressure. A gasoline extraction plant is usually built at some convenient location on a natural gas line. When all of the various sections of the line have been connected, it is tested at high pressure for leaks, and, if satisfactory, is pronounced ready for service.

Each pipeline project presents a different set of problems that must be worked out by the engineers in charge, or by the specialists under their supervision. Unusual topographic conditions are frequently encountered, such as canyons, swamps, quicksand, and crossings under highways, railroads, or rivers. As most pipelines traverse comparatively rough country, it is frequently necessary to build roads for transporting pipe and other materials. In rocky country, it is necessary to dig some sections of a trench with pick, shovel, and explosives, instead of with ditching machines that can ordinarily prepare several miles of trench a day.

ONE pipeline company owns 12,500 miles of trunk and gathering oil lines, including one trunk system extending from Tiffen, Texas, through Oklahoma and Kansas to Carrolton, Missouri. There it branches, one line going east to Wood River, Illinois, and the other northeast through Iowa and Illinois to Griffith, Indiana. This company's lines deliver more than four million barrels of crude oil a month, in just three of the mid-continent states. Of the major projects now under construction, the largest is the Texas-Empire trunk pipeline consisting of 636 miles of 12-inch pipe. Its terminals are Tulsa, Oklahoma, and Chicago, Illinois. Several projects more than 400 miles in length are now under construction in Texas.

During the past year, many important natural gas pipelines have been constructed, and several of equal or greater size are now being built. Among those which have been completed recently, or are now under construction, the following are most notable: from the Panhandle fields in Texas to Denver and Kansas City;



PUTTING THE FINISHING TOUCHES ON A NATURAL GAS TRUNK LINE

After the trench has been prepared, the pipe is welded or coupled, and a coating of paint or enamel is applied for protection against corrosion. The pipe is then ready to be buried

from Baxter Basin in Wyoming to Salt Lake City; from Lea County in New Mexico to El Paso; from the Buttonwillow field in California to Oakland and San Francisco; and from the Louisiana fields to New Orleans, Memphis, St. Louis, and Birmingham.

An interesting feat of engineering was accomplished in constructing the Mississippi River crossing when the natural gas pipeline from Monroe, Louisiana, to Memphis, Tennessee, was built. Lyon F. Terry of the Ralph E. Davis engineering organization supervised the construction of the line, including the river crossing. Massive concrete headers were built just back of both levees, where the 18-inch trunk line was subdivided into four 10 inch pipes about 12,000 feet long.

FROM levee to levee, the line had to traverse two thickets, two small lakes, a swamp, an 800 foot mud flat, and the 3000 foot main channel of the river, which was about 80 feet deep at that point. Ten-ton concrete anchors were placed at intervals across the main channel, and the pipe was joined together and lowered from barges and pontoons, held in place by the anchors and two tug boats. The joints were screwed together, fitted with collar leak clamps, coated with bitumastic enamel, and weighted with 1800-pound river clamps. The four parallel lines lie in a neat up-stream bow, designed to withstand the periodic rampages of "old man river."

Corrosion causes more than 100 million dollars worth of damage to pipelines every year. As a result, the cause and prevention of soil corrosion has been the subject of much study

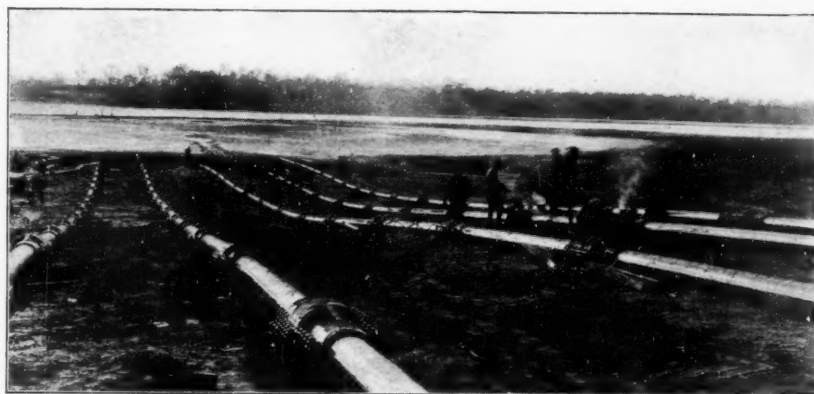


Photo courtesy Ralph E. Davis

TRANSPORTING NATURAL GAS UNDER THE MISSISSIPPI RIVER

When crossing a large river, several small parallel lines are built, with heavy weights to keep the pipe in place. The joints are screwed together, carefully enameled, and heavily weighted

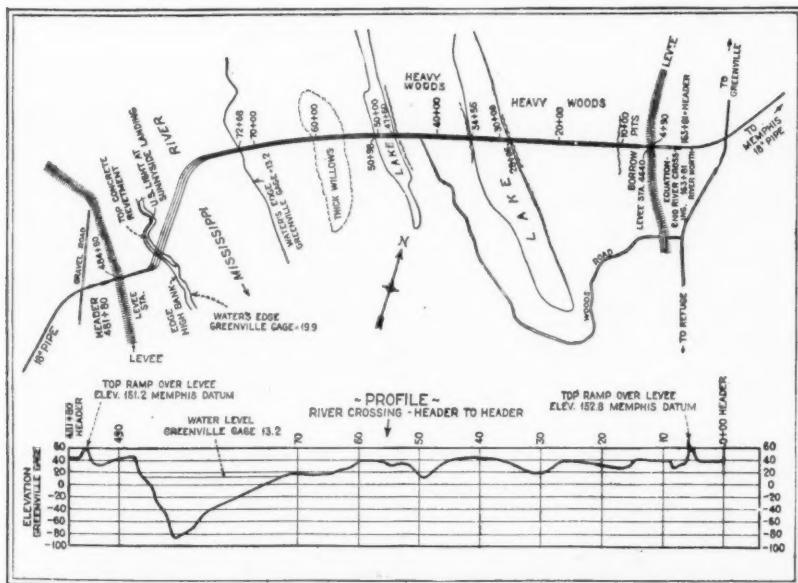
and research. It has been definitely established that corrosion is severe in some soils, moderate in others, and in some areas it can be considered almost negligible. Protection against rust is principally a matter of insulation—if moisture and corrosive salts or acids can be kept from the surface of the pipe, corrosion will cause no trouble.

The most effective protection against severe corrosive conditions is heavy cast iron pipe, or such metals as are known to be resistant to oxidation or rust. But in the interest of economy, wrought iron or steel pipe is usually used, and to guard against untimely destruction, paints or thick coatings of asphaltic or coal-tar-pitch material are usually applied. In extremely dangerous areas, wrappings of asbestos or felt are sometimes added to keep the coating in place, although a well-applied layer of protective

enamel will withstand corrosion almost indefinitely. By means of a complete corrosion survey, in which the surface characteristics and the inherent corrosive characteristics are evaluated, it is possible to determine the potential corrosiveness at all points along a pipeline right-of-way, or in such areas as gas or water distribution systems.

CONNECTIONS and joints are the most vulnerable part of most pipelines, and are frequently the source of leaks or breaks. A new expansion joint has recently been perfected for use on all-welded lines, which automatically absorbs expansion and contraction, acts as a bending medium, and provides a leak-proof joint. Another device recently developed for use on long-distance high-pressure lines is a coupling coater, which is a hinged aluminum form built to clamp tightly around the coupling. The melted enamel is pumped into the bottom of the form, until it completely submerges the coupling; the excess enamel is then drawn out, by reversing the pump, and the coupling is left with a perfect coating.

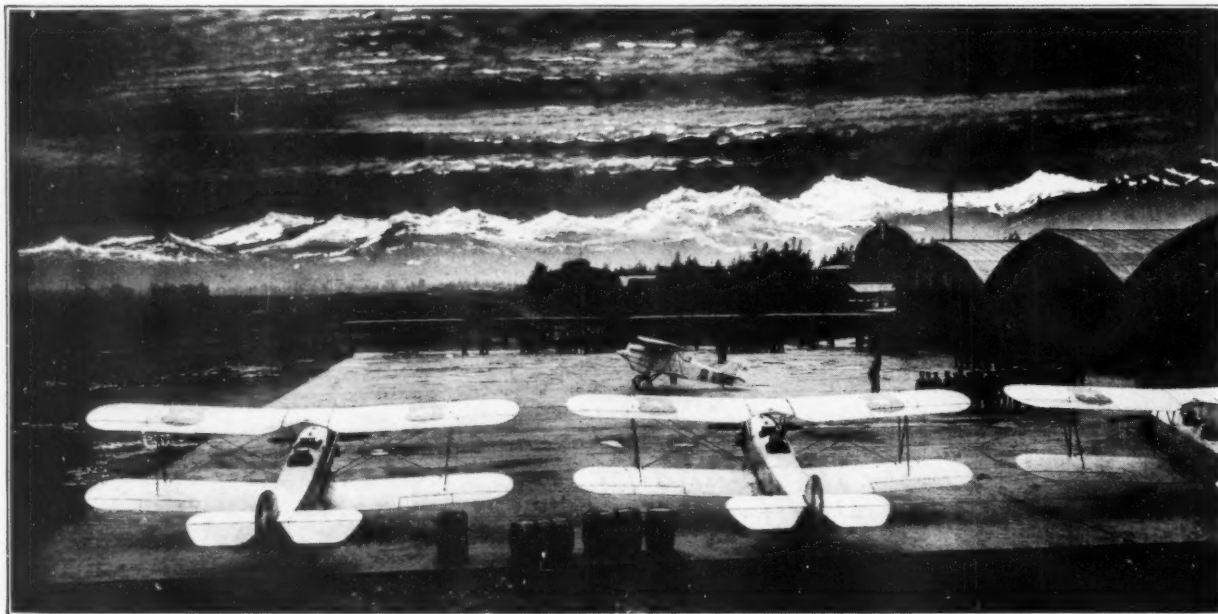
Centuries ago people worshipped at "the everlasting flame" of Baku, an immense petroleum and natural gas deposit in the near-east. Today a 500 mile pipeline transports oil from Baku to refineries on the Black Sea. The line was welded by an American concern. In the Rhinish Westphalian industrial district of Germany, a 550 mile network of 16 to 32 inch pipelines transports manufactured gas from the generating plants near the coal mines to industrial and domestic users. Manufactured gas is supplied to 317 communities in Illinois by 1,269 miles of inter-city mains, and similar lines connect communities in New England that are dependent upon central generating plants for their supply of gas. Several cities in the middle west are now using natural gas to enrich their manufactured gas, with excellent results.



Redrawn from blueprint, courtesy Ralph E. Davis

HOW "OLD MAN RIVER" WAS CONQUERED

Although it is 12,000 feet from levee to levee, the main channel of the river is about 3000 feet wide at low-water stage. Note the up-stream bow in the pipe across the main channel



Photograph courtesy Chile

WAITING FOR THE SUNRISE

Dawn at "El Bosque," modern airport recently established in Chile, "The Lone Star Republic"

Wings of South America

Aerial Transportation Between the Continents of the Western Hemisphere Is Increasing by Leaps and Bounds

By ANNIE S. PECK

Author of "The South American Tour," "Industrial and Commercial South America," etc.

THE opening in May by the Pan American-Grace Airways, Inc., of the first regular air-mail service from the United States to South America, by way of Panama down the western coast, is to us as important as was to Europe the mail service from France to the eastern coast of South America, inaugurated in 1928. The east coast, too, now receives our attention, as in August a service will be opened by the New York, Rio and Buenos Aires Line, Inc. Thus a great stimulus will be given to inter-American trade and travel, promoting closer relations between the peoples of the continents of North and South America.

But let no one fancy that the sight of airplanes is a novelty to our southern neighbors. South America has been less laggard in aeronautical development than we may imagine. The friendly visit of Colonel Lindbergh to Central America, Colombia, and Venezuela, stimulated interest in aviation in the countries this side of Panama and was very welcome beyond, although there no stimulus was needed, since Colombia was the first country on this hemisphere to install regular air-mail and passenger service on a definite schedule.

We are justly proud of our world-

famous Wright brothers, the first to fly in a ship heavier than air—14 seconds in 1903, and more than an hour in 1908. But we must not overlook the skill and valor of the South Americans. It was a Brazilian, Santos Dumont, who, in a ship lighter than air, first flew, in 1901, around the Eiffel Tower, and in 1903 landed gracefully at his own doorway in Paris. A Peruvian, Georges Chavez, was the first to cross the Alps in an airplane. In 1918, the more lofty Andes were first traversed by a Chilean aviator, Lieutenant Godoy, while in 1923 the more perilous passage from east to west was accomplished by a French lady, Mlle. Bolland, alone, in a little plane with an 80-horsepower motor.

THE peculiar physiography of the South American continent is such that practical aviation is of far greater importance to its people than to us. Their mountain ranges are more lofty and extensive than our own and the interior includes an immense, high plateau region. In Peru this plateau is cut by many canyons too wide to bridge, and so deep that in four cases a descent of more than 5500 feet must be made before climbing up the other side. In other sections are enormous

forests, jungles annually inundated for hundreds of square miles, and extensive regions inhabited only by wild beasts, snakes, and sometimes by tribes of savage Indians.

The Spaniards in South America, unsurpassed in boldness and hardihood by those of any other time or race, were not content with founding cities along the coast. They explored and made settlements in the very heart of the continent. But they were followed by no swarms of immigrants, such as helped to populate our coasts and our more friendly hinterland. Confronted by almost insurmountable natural barriers, anything approaching an adequate system of transportation has been for them impossible, save over the broad pampas of Argentina and in Uruguay, where British capital long ago came to their aid. It was the countries with more difficult topography that earlier turned to regular aviation service; first there was Colombia, and then came Bolivia, followed by Peru, Chile, and Brazil.

Bogota, capital and chief city of Colombia, lies on a plateau 8650 feet above the sea, 700 miles from the northern coast, and 350 miles from the Pacific. From the west, two mountain ranges must be crossed, the first by rail, the second by motor road

and bridle path over a pass 10,000 feet above the sea. The usual route is from the north, up the Magdalena River, 1000 miles long, but because of shoals and shifting channels, the passage may be impracticable for weeks. Under favorable conditions the trip can be made in 10 days.

While Americans were thinking more of feats like the transatlantic passage, Colombians formed the Sociedad Colombo Alemana de Transportes Aereos, called Scadta. With German planes and aviators a weekly service was installed in December, 1919, from Barranquilla, an important city near the mouth of the Magdalena River, 622 miles up the valley to Girardot.

THE all-metal Junkers seaplanes now give mail and passenger service daily except Sunday, when freight is carried. At Calamar travelers who have come by rail from the famous old city of Cartagena are taken on. At Puerto Wilches connection is made by land plane, three times a week, with Bucaramanga, capital of the Department of Santander. Barranca Bermeja, the next halt, is interesting to Americans as the river port of the oil wells near by, operated by the Standard Oil Company of New Jersey. A stop is made at Puerto Berrio, notable as the river port of the enterprising and wealthy city of Medellin, a center of trade in coffee, gold, and manufacturing industries. The 10-hour air journey terminating at Girardot may be followed next day by a seven-hour trip by rail to Bogota. Once a week a plane makes a round-trip flight from Girardot to Neiva, at the head of navigation on the river. It is noteworthy that Colombia's airplane service, receiving no subsidy from the government, has been profitable from the beginning and gradually extended.

Twice a week flights are made from Barranquilla to Santa Marta and return, there connecting with the United



SOME OF THE AIRWAYS TO AND IN OUR SISTER CONTINENT

Fruit Company's steamers making the quickest time to the United States. A five-hour flight is made each Thursday from Barranquilla to Cartagena, Sautata, Quibdo, Istmina, and Buena-ventura. At Sautata this plane is met by a Scadta plane from Colon from which passengers may be transferred for the journey south to Guayaquil. On Friday, a seaplane continues down the western coast, calling at the ports of Tumaco, Esmeraldas, Bahia de Caraquez, Sta. Elena, and Guayaquil, the port for Quito, capital of Ecuador. Permission

to continue from Guayaquil to Talara or Paita is hoped for.

At the moment, Venezuela has only a government military service to all of its principal cities, with headquarters and an aviation school at Maracay. Civil service is under consideration. British Guiana has an airplane used by officials and for carrying mail, and occasionally for ambulance service from the diamond fields. In French Guiana a seaplane is sometimes employed between Cayenne and St. Laurent.

Bolivia in 1925 inaugurated air service for mail and passengers between Cochabamba and Santa Cruz. The air line distance is 250 miles and is covered in three hours, the planes soaring to a height of 15,000 feet. This air trip, which formerly took 10 days on horseback, has been enjoyed by a lady over 70 and by an infant of three weeks.

The Bolivian Lloyd Aereo, with Junkers metal seaplanes and land planes, has more recently installed monthly service from Santa Cruz to Puerto Suarez on the Paraguay River nearly 500 miles east, and another southward about 350 miles to Yacuibá, on the border of Argentina. A longer journey is made twice a month from Cochabamba north to Trinidad, Guay-



AN AIR PULLMAN ON AN INTERNATIONAL AIRLINE

One of the luxurious tri-motored planes used by the Pan American Airways, Inc., in their air service from Miami to Havana. Twelve passengers and a crew of three are carried



Photograph courtesy Chile

AT "EL BOSQUE"

Planes of the Chilean army are shown here flying in formation over the recently dedicated landing field

Calls below Guayaquil include Talara, the oil port for the International Petroleum Company, and the important cities of Trujillo, Lima, and Mollendo.

A service of very great value, although not entirely by air, is from Lima to Iquitos on the Amazon. Formerly it was a journey of about 15 days by rail, motor, horseback, and river boat. The only alternative route was to sail by way of Panama to Para, Brazil, and then 2300 miles up the Amazon River to Iquitos. The first airplane journey by passengers over the direct route was made by a gentleman and his daughter as a pleasure trip. They found the flight by seaplane from Iquitos to Masisea so agreeable that they decided to proceed by land plane, arriving at five the same afternoon at San Ramon in the beautiful Chanchamayo Valley. The next morning they rode by motor car up to Oroya, thence across the Andes by

train to Lima, where they arrived in less than 36 hours from Iquitos; a striking illustration of the usefulness of airplanes in South America.

Chile is also interested in developing rapid communication by air, although, unlike Peru, it has no urgent need to reach a remote interior. Few parts of the country are much more than 100 miles from the coast. A daily service by the Latecoere Company is in operation between Santiago and Valparaiso, so that mail may be sent to the port on the day of steamer sailing or be received in Santiago on the day the boat arrives.

ARGENTINA has had a German service, occasionally suspended, from Buenos Aires to Montevideo; but now there is daily service shared by three companies, German, French, and Argentine.

In addition to the weekly service from Europe, Brazil now operates one of its own through the Condor Syndicate, Ltd. At first weekly but now twice a week, Dornier and Junkers seaplanes go south from Rio de Janeiro, calling at the famed coffee port of Santos, and at Paranagua, terminus of the railway from Curitiba, capital of Parana. Other calls are made at São Francisco, Florianopolis, and Porto Alegre. There is continuation service to Pelotas and Rio Grande. This air journey from Rio to Porto Alegre is made in one day instead of the five required by boat or train. From Rio to São Paulo a daily service is in operation, with a weight allowance, including baggage, of 167 pounds.

The weekly French air service from Europe to South America has been operating since March 1928 from Toulouse to Buenos Aires, covering the one way trip in eight or nine days. The route followed is from Toulouse, France, to Casablanca, Morocco, 1147 miles in 13 hours; then to St. Louis, Senegal, 1767 miles in one and one half days. Changing to seaplane, the



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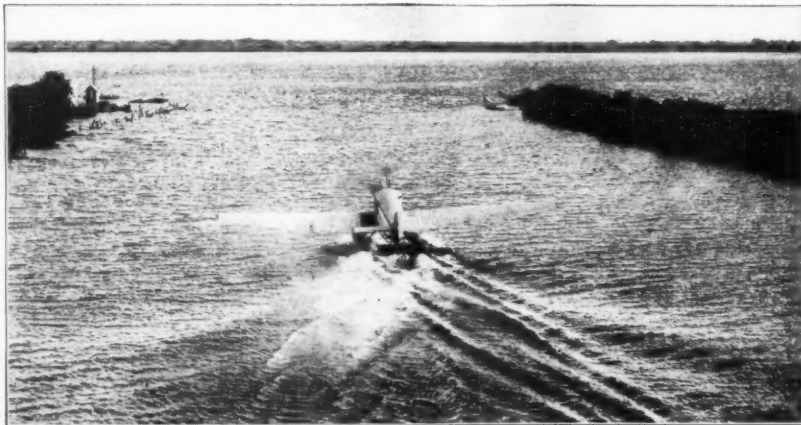
aramerin on the Madeira, Mamore Railway, and to Riberalta. A seaplane is used from Todos Santos to Trinidad and beyond, where rivers are followed. Here the airplane performs a wonderful service to settlements situated in an immense wilderness.

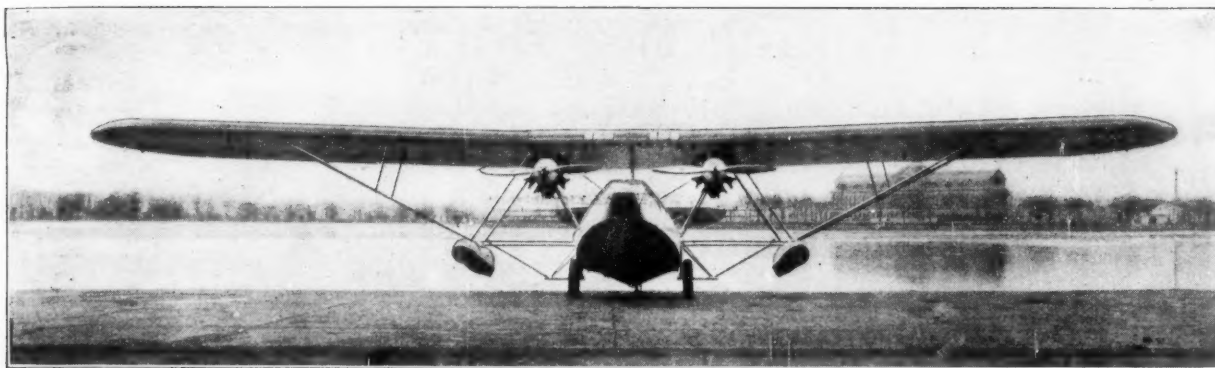
Peru, after some experimenting, has inaugurated regular air service. The Peruvian Airways Corporation, a W. R. Grace and Company organization, began in 1928 to operate along the Pacific coast from Mollendo to Guayaquil. Now controlled by the Pan American-Grace Airways Inc., this line is operated in connection with the through service from the United States inaugurated in May.

AIR-SEAPORT

At the left and below are two views of the seaplane base at Barranquilla, Colombia

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Photograph courtesy Consolidated Aircraft Corp.

ONE OF THE TWENTY-PASSENGER "COMMODORE" AMPHIBIANS USED BY NEW YORK, RIO AND BUENOS AIRES LINES, INC.

journey continues to Cape Verde, 402 miles in five hours. From Cape Verde the mail is taken by steamer to Isla Fernando da Noronha, a rocky islet belonging to Brazil, 1364 miles in three days. Seaplane service is then resumed. After a five-hour flight, Natal is reached. The remaining 1200-mile flight to Rio de Janeiro occupies 14 hours, including calls at Pernambuco, Maceio, Bahia, Caravellas, and Victoria. The journey to Buenos Aires requires 15 hours, with intermediate calls at Santos, Florianopolis, Porto Alegre, Pelotas, and Montevideo. Chile is served by rail in 36 hours more, but it is planned to extend the air-mail route over the Andes, it is said, to Copiapo. There is now airplane connection with Asuncion, Paraguay.

The new service of the Pan American

used as far as Guayaquil or Talara and land planes beyond.

The route followed by the Pan American line is from Miami to Havana, Cuba, with a call at the fuel station La Fe, at the western corner of the island; then to Puerto Morelos in Yucatan, where United States western mail will be received from Brownsville, Texas, by way of Tampico, Vera Cruz, Merida, and other Mexican cities. This service is performed by the Compania Mexicana de Aviacion, controlled by the Pan American Airways. From Puerto Morelos, the Miami service continues in two days to Belize, Tela, Managua, Puntarenas, David, and Cristobal. From Cristobal south, service is by the Pan American-Grace Airways, Inc.

The first call in South America is at Jurado, for fuel; the second at Buena-

and Montevideo, this route to Buenos Aires being shorter than by the east coast.

A Pan American Airways service now extends from Miami to Nassau; a second to Camaguey and Santiago de Cuba, to Port au Prince, (Haiti), and to Santo Domingo and San Juan (Porto Rico). This service may be extended to Guadeloupe, Martinique, and Port of Spain. Another may be arranged from Cristobal by way of Turbo, Cartagena, and Barranquilla to Maracaibo, Curaçao, Maracay, Port of Spain, and beyond to Georgetown, Maramaribo, and possibly to Para, Maranhão, Natal, and Pernambuco.

At the time of writing, weekly service from Montreal to Miami is being instituted by the Pan American Airways. In July it is expected to make this twice weekly. Thus 8000 miles may be covered by air from Canada to points in South America.

The New York, Rio and Buenos Aires Line, Inc., has planned the following service: First day, New York to Miami, with calls at Baltimore, Washington, Norfolk, Wilmington (North Carolina), Charleston, Savannah, Jacksonville; second day, to Port au Prince, (Haiti), with calls at Havana, Cienfuegos, Camaguey, Santiago; third day, to Port of Spain, (Trinidad), calling at Santo Domingo, (Porto Rico), Basse Terre (Guadeloupe), Fort de France (Martinique); a branch line from Trinidad to Caracas; fourth day, to Para, (Brazil), with calls at Georgetown, Paramaribo, and Cayenne in the Guianas; fifth day, calls at São Luis de Maranhão, Fortaleza, Natal, Pernambuco; sixth day, Maceio, Aracaju, Bahia, Caravellas, Victoria, São João de Barra, and Rio de Janeiro; seventh day, Santos, Paranagua, Porto Alegre, Pelotas, Montevideo, and Buenos Aires. Eight Sikorsky planes, each accommodating eight passengers have been ordered, and six Commodores, accommodating 20. Service beginning in August is expected to be weekly before the end of the year—a very ambitious program.



A CLOSE-UP OF THE HANGARS AT BARRANQUILLA'S AIR-SEAPORT

Airways from Miami to Cristobal, and of the Pan American-Grace Airways from Cristobal to Mollendo, with early extension to Santiago, is a most welcome addition to local operations. An amicable arrangement was made with Colombia by the signing of a treaty which permits Seadta ships to land at Colon, and United States planes to land in Colombia. Expert pilots have been engaged for the service. Sikorsky amphibion planes are

ventura. The next day calls are made at Tumaco, Esmeraldas, Bahia de Caraquez and Guayaquil. One day serves for calls in Peru at Talara, Trujillo, and Lima; another day for Ica, Lomas, and Mollendo, or beyond to Arica in Chile. Iquique, Antofagasta, Caldera, Serena, and Santiago will be served in two days more. Within the year, service may be continued over the Andes to San Juan, Cordoba, Rosario, Buenos Aires,

Foiling the Burglar

From Time Immemorial Man Has Tried to Protect His Worldly Goods From the Hands of the Despoiler

By ALBERT A. HOPKINS
Author of "The Lure of the Lock"

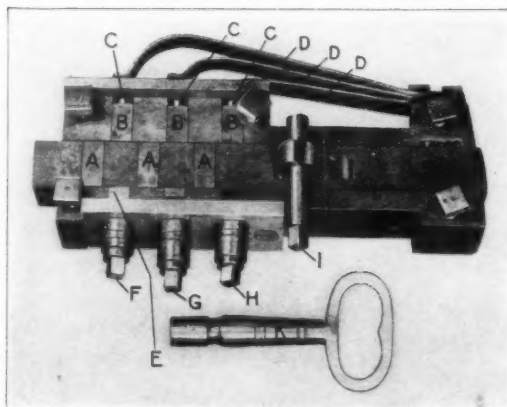
PEOPLE have been protecting their possessions for thousands of years, and Biblical references are numerous. The locks were crude and cumbersome, but they evidently kept the thief at bay most of the time. In the middle ages the château locks were massive and ornate, and gave little protection. It was in England that the modern lock had its inception. The Bramah and the Chubb locks were famous and a considerable part of the strong boxes of the world are still protected by Chubb lever tumbblers. The locks of the United States are one of the glories of American invention. The names of Yale, Sargent, and Towne are in the front rank of the inventors of America, and their products are in use in every country of the world, civilized and uncivilized. Not far from that busy strand of life, Fifth Avenue, New York, is a little-visited collection of locks. It is our privilege to illustrate some of the locks from the J. M. Mossman collection in the museum of the General Society of Mechanics and Tradesmen at 18 West 44th Street, where they are gladly shown.

WHEN we are dealing with locks, strange to say, the word "key" means nothing in particular. It may be a little piece of metal with holes drilled in it; it may mean a pocketful of washers, or numbers or letters which, through proper mechanism, serve to release the bolt. We hear of "burglar-proof" safes and vaults

being cracked, and "fireproof" safes being burned up and their contents destroyed. These terms are merely relative and mean that at the time the safes or vaults were built they resisted burglars and fire most of the time. Now we can build vaults which are impregnable both to fire and the yeggman. It took more than a century, however, to evolve the perfect protection, which is very costly. A banker now finds that it pays better to put 50,000 dollars in a vault than to have perhaps 200,000 dollars stolen. While money can be insured, there is more satisfaction in conserving it than losing it.

Burglary is one of the poorest paid of the learned professions. Warden Lawes, of Sing Sing, shows that the average receipts from a haul are \$43.22, while forgery pays better, 5,870 dollars

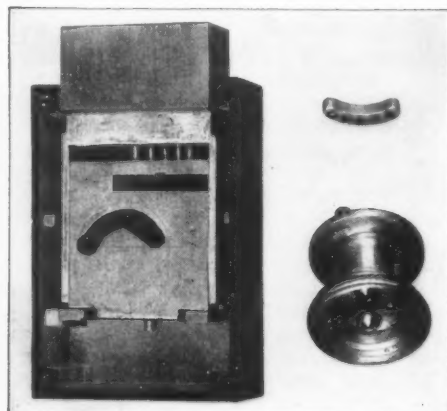
being the average net proceeds. Seventy-one percent of the burglaries are futile. Not a very going business, is it? Some writers and moving picture directors picture crooks as lovable, generous to a degree, always ready to "kick in" with their fellows, and never squealing on a pal. As a matter of fact, they are cruel, always ready to "gyp" their mates of their share of the spoils, and always ready to save their own hide at any cost. "Honor among thieves" is a *rara avis*. Burglary will soon be as lost an art as wood-engraving. The hold-up man is running very strong at the present time. Neither the skill of the cracksman nor his patience is required in this brutal game of "stand and deliver." It is a sad commentary on the times when our streets are filled with armored cars, and money can only be transferred with the finger on the trigger.



PERKINS LOCK OF 1813

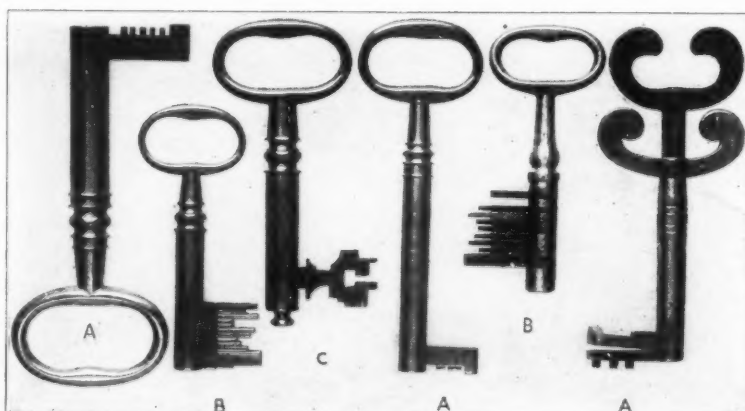
This ponderous lock was beautifully designed. The "keys" were the washers, which allowed the bolt to move

THE movies do a lot for the rehabilitation of the crook, probably without intending to do so. You see the burglar listening to the turning tumbler and presto—the bolts will be undogged; but alas, there is no "Jimmy Valentine." In order that this matter might be disposed of once for all, the writer consulted a great lock expert who said: "In answer to the question, 'Can anyone pick or manipulate open a good combination lock when properly applied?' I would say 'Perhaps, yes, but unfortunately, the real Jimmy Valentine is always out of reach. He seems to live on the



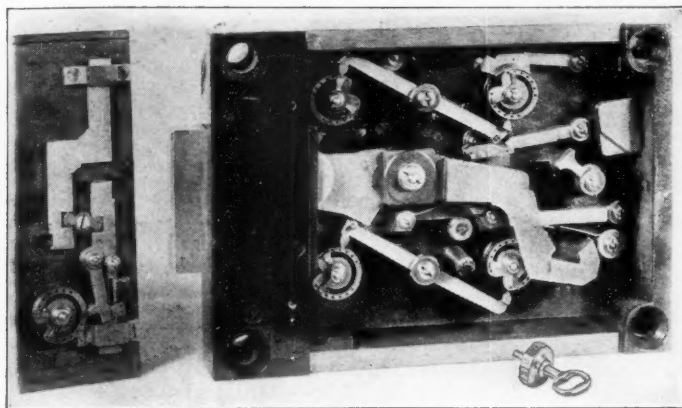
OLD YALE PIN LOCK

The key is the brass segment which is inserted in the knob and is then automatically ejected



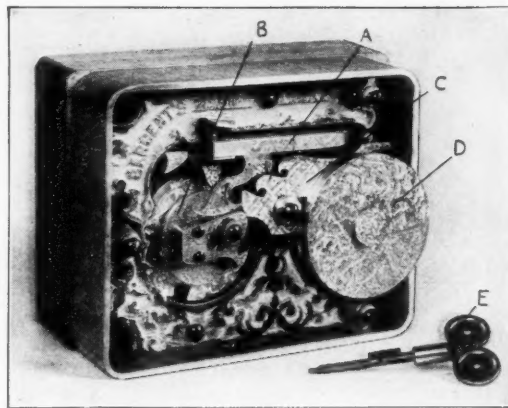
WHEN KEYS WERE KEYS

Some of the keys (A) have removable pins, others (B) have removable tumbler lifters, or "bittings," still others (C) had plugs to keep out dirt. These keys are all of large size



BUTTERWORTH COMBINATION LOCK OF 1846

This was one of the progenitors of the combination lock. There are three "stacks" of rotary tumblers set by a key. The back locks on with a dial



SARGENT MAGNETIC LOCK, 1866

This was a combination lock with magnets which kept mechanism out of contact until the setting was complete

desk of some scenario or story writer, and can't be found available."

"The above is about all that I think we need say; if anyone knows better, then let him bring forth the man. I have seen 29 years of bank lock work, and have been associated with a great many people who lived back of my time, and while there are certain things that a man can learn, and a certain knowledge that we have of these devices, yet it is still true, I believe, that any good five dollar combination lock properly applied and properly set is non-pickable so far as you and I mean. If this were not true, then we are certainly wasting a lot of time and money, when, in the event of a lockout on a safe or vault door, we cut through the door, or through the side of the vault or safe to gain access and make the repairs.

"In the first place, if you put three or four wheels on a shaft, and turn one or all around, you have the average combination lock operation, so far as the tumblers are concerned. The word 'tumbler' seems to indicate to most people that something drops down, and in nine out of ten reports, you will find mention of the dropping of the tumblers, whereas there is nothing that drops, so far as the tumblers are concerned. The earmark of truth is not in the story. The earmark of untruth or hearsay is in nearly every one of these stories in that one set statement 'Hear the tumblers drop.'"

in pins C which are held in contact with the bolt proper by powerful leaf springs, D. At F, G, and H will be noticed studs having square heads. On these studs will be seen a series of washers which are really the "key." When the banker went home he took his washers with him. On the morrow he unscrewed the studs, placed the washers on them according to a pre-arranged setting, and screwed the studs home. If the setting was correct there would be nothing in the path of the blocks A, each within its slot, lining up with the bolt, and a throw of the wrench K on square head I would

Another keyless lock was invented by the elder Linus Yale. The key is a segment of brass with holes of varying depths drilled in it. The "key" is pushed through an aperture in the knob, which is then turned. The key passes through the lock, raises the pin-tumblers and discharges itself through the knob handle after allowing the bolt to be retracted. Although this is a freak lock it was the precursor of the pin-tumbler lock.

THE Yales, father and son, invented many locks of great ingenuity which were towers of strength until the coming of the combination lock. In our illustration of keys will be found at B a type of key in which the "bitting" could be changed and the lock would set itself to operate only with the changed key so the banker could have a new combination every day if he wanted it. Keys were large and the barrels were apt to become clogged with dirt so a metal plug was used (See key C) and we find in "Pickwick"—"Mr. Lowten replugged and repocketed his Brahmah." Keys were keys in the old days and not mere slices of metal. If you carried four or five keys you had a decided list to port.

The combination lock set the burglar back for quite a space of time. With four tumblers and one hundred numbers on the dial there are 100,000,000 possible changes, all of them equally useful. Inventors worked on combination locks for a long period but the problem would seem to have been solved by J. H. Butterworth of Dover, New Jersey, who invented a cash drawer with a stack of four tumblers and a locked back on the cover. He then made locks with two, three, and four stacks of tumblers, making a very safe lock, and to crown all, he locked on the cover with a real dial and not a removable dial key with letters. We

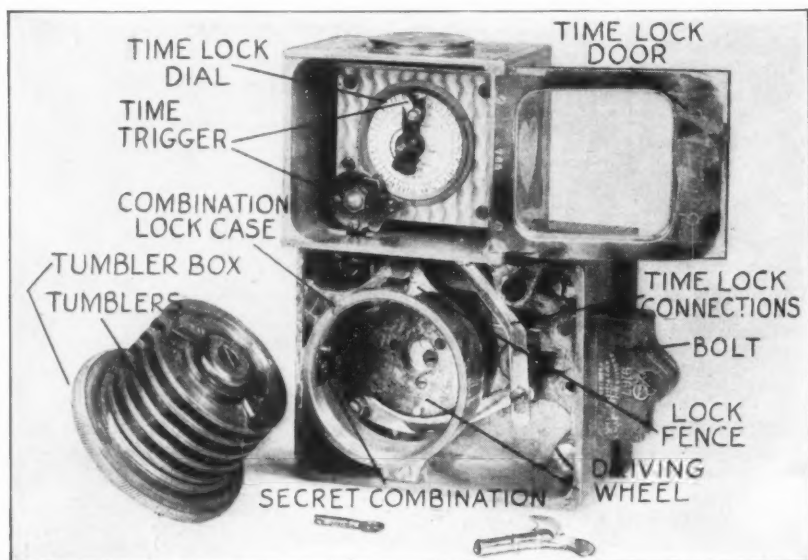


LIQUID TIME LOCK, 1877

The case is divided and liquid flows between each part until both are equal; then a weight revolves the lock

SOME of the earlier American locks are so extremely complicated that it is a wonder they functioned at all. Some of them, however, were very clever even in their simplicity, as the Perkins lock of 1813 which is interesting because washers are the keys. Three channels are milled out of the bolt proper which are normally filled with blocks A. Movable blocks B terminate

retract it. If a stranger should attempt to open the lock with duplicate washers what would happen would be that if the combination was wrong, one of the blocks E would force a block A into the channel occupied by block B, thereby dogging the bolt. A considerable number of combinations were possible, and the lock was used until quite recent times.



SET A LOCK TO WATCH A LOCK

Here we have a combination and time lock with a secret combination known only to the manufacturer. In case of a "lock out" the banker telegraphed the maker for the secret combination

illustrate this beautiful piece of mechanism.

Burglars found that the combination lock could be picked by forcing the bolt back so as to get a contact with it and the edges of the wheels, by which their position was ascertained. In 1866 a prominent lock inventor and manufacturer, James Sargent, conceived the idea of using a magnet which served to hold up a lever, or dog, until the tumblers are brought into line by setting the proper combination. The lever does not rest on the wheels, nor is it brought to them by a spring, but is sustained by the magnet. Every time the knob is turned around, the magnet is separated from the lever which then falls to the wheels, and if the slots in the wheels are in line, drops into them, thus releasing the bolt. Combination locks were all right until the advent of the "masked burglar" who kidnapped and tortured the cashier and possibly his family as well. There was no let up in the eternal battle and as several bankers were murdered, the inventors tried to gain on the burglar, and give some sleep to bank officers and other custodians of funds.

At last the time-lock was evolved by which a clock or clocks were put to watch the vault, from the inside, so that neither friend nor enemy could open until the appointed time. The time-lock still remains the great bulwark after the first line of defense, the vault itself. The evolution of the time-lock is a long chapter in the history of invention. Bankers were skeptical about the ability of a clock to control their openings, but the masked burglars waxed bolder and something had to be done—the time-lock was the only solution. It was soon found that

the clock was likely to go the way of any clock, so it was found feasible to put in two clocks instead of one, and three clocks gave even more security.

A TIME-LOCK usually has four movements, any one of which will serve to release the mechanism of the bolt-work. While we use the word "clock" we mean something between a watch and a clock, more like a chronometer. The time movements never "run down" so as to stop from an exhausted mainspring; but after the dials have reached zero, which is the unlocking point, they run on for a given time—say 30 minutes—and are then brought to a standstill by stop-works arranged for the purpose, while at the same time, the reserve maintenance power will cause the movements to run for an additional fifteen minutes before coming to a complete stop. Bolt operating motors were largely used until about 1914. These were heavy spring motors which were released by the time locks located directly above, on the inside of the vault door. As bolt work became more complicated and heavier, manual opening and closing was resorted to, and now all the time-locks do is to remove a slight but entirely adequate impediment to the free movements of the bolts.

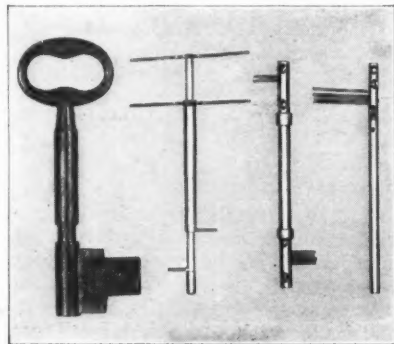
Freak time locks were much in evidence and one of the most interesting and ingenious was invented in 1877. This was a liquid time-lock which we illustrate. The cylindrical case turns on its axis. There are two chambers formed by a transverse partition. A small orifice allowed the liquid to pass slowly from one side to the other. When the liquid in each division became level, a counterweight attached to one side of the case caused it to

rotate so that one of the cells in the edge of the case came opposite the tongue of the bolt work so that the latter might be retracted from its locked position.

We illustrate another curious lock which was a combined time and combination lock, which was nothing unusual in itself, but it also contained a secret combination in case of a "lockout." This secret combination was held by the makers until an emergency arose when it was telegraphed to the bank.

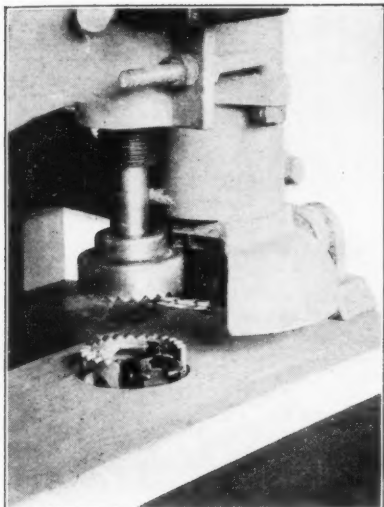
NO article on burglary would be complete without some reference to "lock picking" and burglar's tools. In the middle of the last century lock picking became a great indoor sport, especially in England. "Wherever there is a keyhole, a lock can be picked." This is the dictum of a famous American inventor on whose locks the sun never sets. The element of time is as great a factor in lock picking as in vault cracking. We have seen two expert locksmiths try to pick a simple lock on the glass door of a time-lock and after they had spent more than half an hour with their picklocks give it up in disgust. Lock picking tools depend on the principle that whenever the parts of a lock come in contact with the key they are affected by any pressure applied to the bolt, or to that portion of the lock by which the bolt is withdrawn. Wherever these points of resistance to the withdrawal of the bolt can be determined, such a lock can be picked. Our illustration shows tools used by legitimate openers of safes and locks and which would be equally useful to the professional burglar.

Burglars in the late seventies carried around an immense quantity of tools. If they were discovered they usually left behind them implements costing nearly 2000 dollars. The tools were made by expert mechanics whose labor was probably very expensive as they had a "corner" on their underworld products. A motor truck would have been most convenient for the old-time burglar.



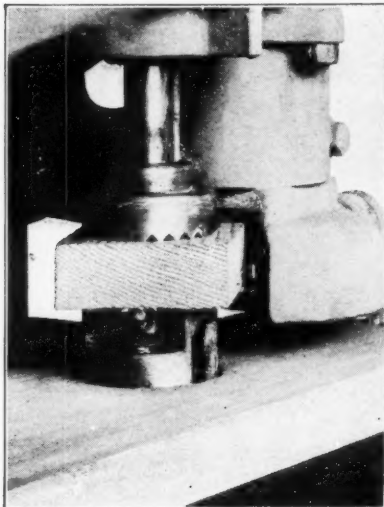
LOCK PICKING TOOLS

Blank for obtaining a wax impression and movable picklocks for raising tumblers



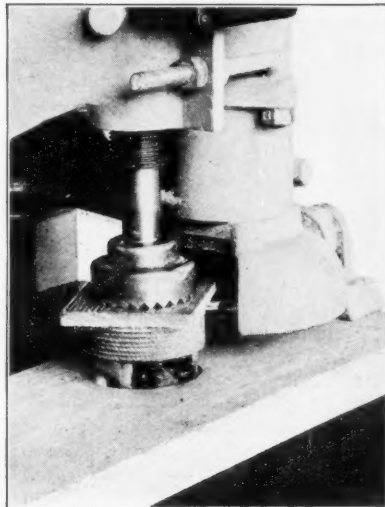
THE KNOT IS NOT

The lower spindle has cut out the knot and threaded the hole for receiving the plug



THE PLUG-TO-BE

A block of wood is placed on the projecting lower spindle and held by the upper one



THE PLUG IS CUT

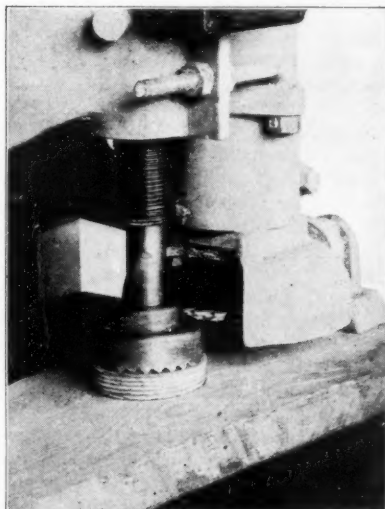
As the spindles rotate and move downward, a stationary tool threads the plug

Plugging Knot Holes to Salvage Lumber

KNOT holes constitute an ever-present and costly problem to builders and to shippers of boxed goods. In the lumber industry, knotty lumber is frequently regarded as practically useless for most purposes and can be sold only for cheap construction work such as fences, small packing cases, et cetera. Shippers sometimes cover knot holes with patches of tin. These makeshift repairs serve to prevent the knot from

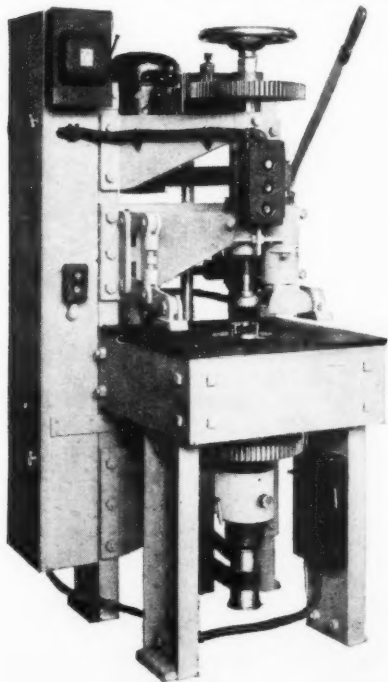
falling out and thus allowing leakage of the contents of the package, but the edges of the tin are dangerous to freight handlers.

A machine placed on the market by a western concern removes knot holes from lumber and inserts a wooden plug which, after being dressed and painted, cannot be seen. The machine is electrically driven, has push-button control, and is so simple in operation that a novice can remove and plug 60 to 90 knots an hour. Knots or knot holes can be removed from either soft or hard wood of any thickness up to three inches. The wood, after being plugged, can be sawed, worked to pattern, or dressed like high-grade lumber.



THE PLUG GOES HOME

As the spindles continue downward, the plug is screwed in place in the lumber



THE lumber is placed on the table of the machine with the knot to be plugged directly over the vertical spindle, and clamped in that position. The spindle is started upward by pushing one of the buttons. As it moves through the wood, it cuts out the knot or knot hole and threads the cut with eight threads to the inch. A block of waste material about the same

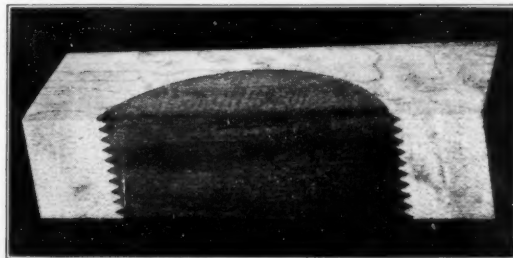
thickness as the lumber is placed on top of the spindle and held securely by a top spindle. The teeth on the two spindles hold this material so that, when the spindles are rotated, the stationary cutter attached to the frame of the machine bites into the block and cuts threads into it at the rate of eight to the inch. As the spindles continue to rotate, the plug is screwed firmly down into the lumber.

◀ LUMBER SALVAGER

The machine which cuts out knots and knotholes and inserts into the bored and threaded hole a plug that, when once dressed and painted, is said to be indistinguishable

A TIGHT FIT ➤

A thick piece of maple into which has been inserted a plug of black walnut. It will be noted that the threads interlock perfectly so that the piece may be machined without splintering



Banditry By Mail

Medical Fakers Fleece the American Public of Millions of Dollars Annually Through the Mails

By S. R. WINTERS

BY means of an iron ring, a muslin handkerchief, common sheep dip, and similar fraudulent schemes, medical fakers exact an annual toll of millions from the gullible American public. The Post Office Department denies many of these the use of the mails, but all of them are not apprehended.

"Long distance bandits" who depend upon the mails for the dissemination of advertisements and literature are divided into two classes; those who deliberately misrepresent, knowing their remedies to be worthless, and those woefully ignorant, who think they have made a wonderful discovery. But, the fountain of youth has not been discovered, and it is not apt to be, in a box of pills. Medical science has not discovered a drug cure for cancer, tuberculosis, and many of the diseases these fakers "cure" with ease.

THE Post Office Department makes clear to the public that: "The reliability of any person, firm, or corporation is not passed on by the department, and the department is not a collection agency and does not undertake to effect the return of any money which may have been lost in unsatisfactory business transactions; but, the Post Office Department does seek to prevent the use of mails in all schemes to defraud, and the Postmaster General may, upon evidence satisfactory to him that any person or company is conducting a scheme for obtaining money through the mails by means of false or fraudulent pretenses, representations, and promises, direct that all mails for this person or company be stamped Fraudulent and returned to the sender. The penalty for using the mails in schemes to defraud is, upon conviction, a fine up to 1000 dollars or imprisonment up to five years (one or both), and every letter mailed in pursuance of this scheme is considered a separate offence."

An investigation is instigated by Postal Inspector D. F. Angier, of Chief Post Office Inspector Grant B. Miller's Office, whose duty is to show that the mails were used for fraudulent purposes, and collect the necessary evidence in co-operation with the Bureau of Chemistry, Department of Agriculture, where these so-called "aids to health" are analyzed. Consideration of the evidence, the conduct of hearings, and the determination of whether or not a fraud order should be issued,

is under the direction of the solicitor of the Post Office Department. Final action is taken by the Postmaster General.

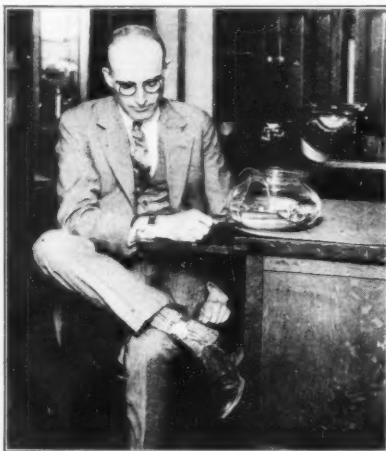
The "testimonial-giver" is the greatest ally of the medical mountebank. He hastens to report a "cure" as soon as he feels the effect of the laxative or the tonic most of these remedies contain. The following endorsement quoted from a pamphlet issued by the "Publicity and Educational Department" of "The Oxypathor Company" is but one instance where the trusting nature of a mother in Ontario, Canada, aided the sale of a worthless device fashioned of nickel-plated gas pipe:

"Gentlemen:
"Our little boy, William Eric, took sick and became delirious. We called two doctors who pro-

Within 18 hours his temperature dropped from 105 to 102½ and he was sleeping naturally—from that time on he improved rapidly—the Oxypathor gets the credit for saving his life, as he never has had one drop of medicine since the machine was first applied."

According to the advertisements of The Oxypathor Company, the instrument consisted of three parts; the polarizer; the treating plates with suitable bands by which contact was made with the body; and two cords or wire cables connecting the polarizer with the treating plates. Upon investigation, it was established that this "Oxypathor" was made of a nickel-plated gas pipe filled with inert material (sand, clay, charcoal, et cetera) and having flexible cords attached.

Not only were hundreds of thousands of these instruments sold in India, Spain, Egypt, Africa, and America, for the cure of Asiatic cholera, cerebro-spinal meningitis, rheumatism, and every other human ailment, but they were also made with wider "contact" bands for animal "cure." However, no provision was made for keeping the horse, dog, cow, pig, or other animal in a fixed position by a bowl or stream of water (in which the "Oxypathor" need be submerged) long enough to insure the instrument's work. A picture illustrating the "Animal Oxypathor" in service, shows a horse tranquilly standing by a brook, with one band strapped around his body, and another strapped around his leg—these bands connected by wire with the "Oxypathor" which is in the brook.



"OXYPATHOR"

The "polarizer" (nickel-plated gas pipe) is in the water in the bowl at the right

nounced it a bad case of spinal meningitis. He was in a terrible condition—his mouth so swollen it was almost closed, and burnt black with the terrible fever, while his head was drawn back. The doctors showed their absolute helplessness to do anything for him. They administered sleeping drops and told us it was only a question of a short time as the fever would burn him up.

"At this stage, when we had given up all hope, our neighbor suggested trying an Oxypathor. She seemed so confident that we telephoned your representative who had one along in short order. We stopped giving the sleeping drops, applied the machine and in three hours we could see a change.

COSTING about \$1.23, the "Oxypathor" sold for 35 dollars, while the "Animal Oxypathor," which cost probably 20 cents more, since the band must be long enough to encircle the animal's body, sold for 50 dollars. The Post Office Department issued a fraud order against the company putting out these instruments, and a fine as well as a prison term was imposed.

John F. and Kate A. Braun have each served a term of three years for selling "Blessed Handkerchiefs." Under the name of Reverend D. R. Schiller, Braun endorsed the divine healing power of his wife, Kate Braun, alias Hulda De Muth. In lieu of personal treatment, these handkerchiefs (which were unhemmed squares of muslin,

costing probably 3 cents) were mailed to sufferers, and a fee of 5 dollars to 15 dollars charged. The patient was instructed to "place the handkerchief over the part of the body affected, and rest in a reclining posture." Beyond this, the directions were not clear, and the length of time necessary to effect the cure was not stated.

IMBUED with the "get rich quick" idea, a comparatively poor pharmacist in Kansas City, Missouri, amassed 1,275,000 dollars in four years by selling the "fountain of youth" in the form of "Genuine Melton Korex Compound Tablets." These tablets retailed for two dollars a box and enabled their distributor to build a 70,000 dollar home and spend over 40,000 dollars for furnishings. When the Postal Inspector investigated this case, he found the pharmacist held in high esteem, being a deacon in one of Kansas City's largest churches and director in a national bank of that city. At the trial of this faker, his counsel introduced a man of 74, who attested that after taking a box of these tablets he was rejuvenated, mentally and physically, to so great an extent that he was only 37 years of age! Ironical as it may seem, this witness dropped dead of old age not six months after his testimony was taken, and his "rejuvenator" sentenced to serve a well-deserved term in prison.

A small wooden ball or arrowhead attached to a string and endowed with the appealing name of "Sex Indicator" sold like wildfire. "Hold this instrument over any object—if the indicator (ball or arrowhead) describes a circle, the male sex is indicated. If the indicator moves in a horizontal line, the object is female. Of particular value is the indicator in determining the sex of lima beans.



All photos Harris and Ewing

UNCLE SAM'S FRAUD DETECTOR

Postal Inspector D. F. Angier, who is directly in charge of fraud investigations. On the desk in front of him is a variegated collection of products under suspicion of being frauds

It is a well known fact that female beans are preferable, and this little instrument is especially valuable to the farmer who may establish the sex of these beans before planting"—stated an advertisement of one of the manufacturers of "Sex Indicators." If this were true, they would undoubtedly be a great help to the student, in determining the gender of French nouns! However, the Post Office Department issued a fraud order against several of the manufacturers of these instruments because they would not do what was claimed.

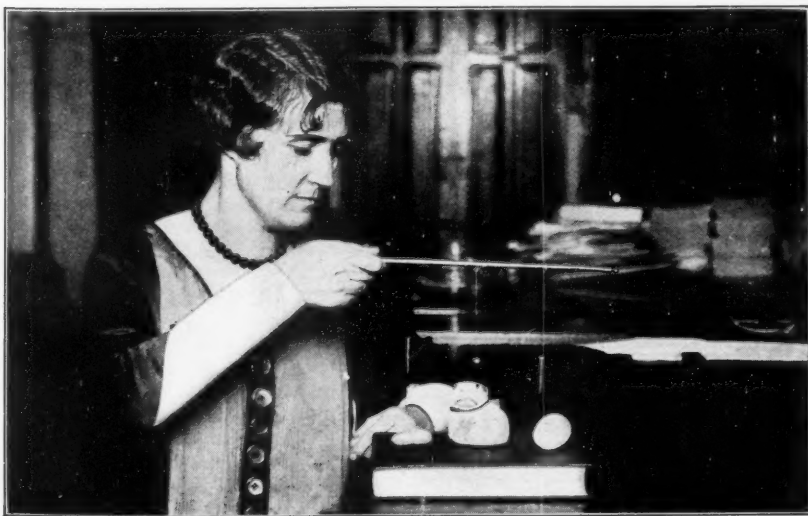
"Look! See what comes through your feet," commanded an advertisement of "Pycosulphene." This powder, which was found to be composed of sodium bicarbonate, borax, sulfur, and starch, was intended to rid the body of all ills by application to the inside of the shoe. Over 60,000

dollars was realized by the manufacturer before the Post Office Department issued a fraud order against him and stopped the sale of "Pycosulphene."

BY putting two drops of Prof. Samuels' Eye Water in each eye, four times a day, all diseases of the human body were "actually cured." Prof. Samuels is said to have taken in over 1,000,000 dollars during the short time he operated, thanks to 90 percent hydrant water, 5 percent salt and 5 percent sugar—of which his "Eye Water" was composed. This solution cost five cents a gallon, and 5 dollars to 25 dollars was charged for two ounces. After serving a term in prison, he is spending his declining years on the proceeds of his ill-gotten gains.

"Amasol," a concentrated solution guaranteed for pyorrhea and sore gums, brought in 48,000 dollars for its "discoverer" in one year. The mixture was common sheep dip employed for killing parasitic insects. In compiling evidence against this company, the Postal Inspector wrote to them describing his hypothetical case of pyorrhea as being so bad that he could remove his teeth from the gums, and put them back. "If your remedy will make my teeth adhere, send me a bottle C.O.D." The remedy came, and the Post Office Department immediately issued a well-merited fraud order.

The Biblical truism to the effect that the way of the transgressor is hard applies with equal emphasis to perpetrators of medical frauds as well as other evil doers. True, in some instances justice is meted out swiftly while in other cases it travels on leaden feet, but Uncle Sam's postal sleuths are ever vigilant and right is vindicated in the final analysis.



CAN THESE THINGS INDICATE SEX?

Three different kinds of "sex indicators" being demonstrated by a post office clerk. They are supposed to indicate the sex of any object whatsoever, whether it is alive or dead



Courtesy The American Museum of Natural History

BIRDS FLYING "IN FORMATION"

Even laymen who have watched migrating flocks of birds and noted the grace and speed of their flight, know that they fly "in resonance" as shown by the groups in this exhibit

Why Not Propel Boats By Vibration?

A Study of the Vibratory Principle of Propulsion in Nature, and the Possibility of Utilizing It for Driving Water Craft

By DR. MANFRED CURRY

MODERN engineering makes use of the propeller as the principal driving mechanism in water and similar fluids. The vehicle, be it a boat or an airplane, receives its motion through the screw-like action of the propeller and this propulsion is dependent on the specific shape of the propeller and on the reaction which it produces in the medium, water or air respectively, in its regular motion according to the continuous flow principle. The efficiency of the screw-propeller is influenced in high degree by the ratio of the speed of the vehicle to the number of revolutions of the screw. Thus, in propelling a boat or an airplane by means of a screw, there is a wide range of inefficient action, within which range the power required is out of all proportion to the resultant speed.

In Nature we find the alternating flow principle used, in preference to the continuous flow principle, by living creatures for their propulsion in air and water. Nature, in general, goes far beyond all human conception in the fitness of her designs, and for this reason we may well assume that the

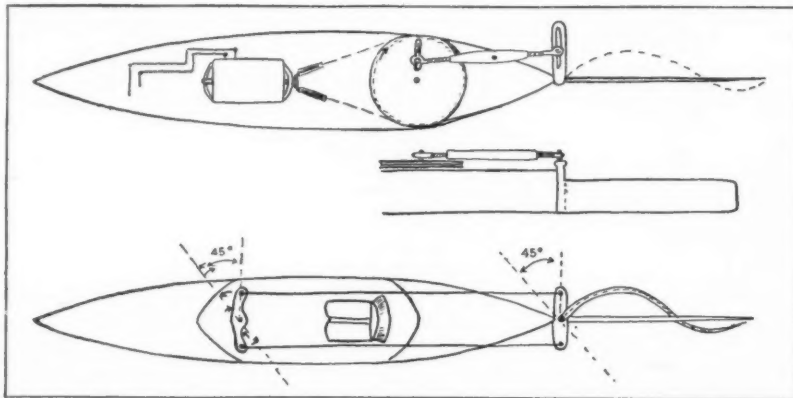
method of propulsion used by birds and fishes is not accidental but was evolved on account of the very high efficiency of the vibratory principle.

Vibration not alone saves energy but it enables the individual animals to couple themselves together through resonance and to utilize the powers thus liberated in their field of excita-

tion. Doubtless Nature could have utilized a rotary movement for the propulsion of her creatures if she had so desired. In fact, the outer edge of a bird's wing does move in circle-like paths. If Nature preferred the alternating flow principle for animals living either in air or water, this principle of propulsion must possess many advantages with reference to efficiency as well as to transmission of energy. That this assumption is true may be proved in the following manner:

LET us regard the motion of a fish and compare it with the motion of a boat propelled by means of a screw-propeller. We find, first of all, a great difference in efficiency. In the case of the screw-propeller the highest possible efficiency is about 78 percent. In the case of the vibratory action of the fish's tail, experiments made at the Technical University of Vienna, Department of Naval Construction, have shown efficiencies as high as 88 to 100 percent. This marked difference will readily be understood if we realize that the efficiency of any propelling mechanism working in any fluid is dependent on the amount of slip, or the so-called "dead water," which is produced by the motion. A rapidly turning propeller of comparatively small diameter will produce a water column of high velocity. It is impossible to prevent this quickly moving water column from being ruptured. This produces behind the screw-propeller a vacuum which cannot be filled fast enough by the on-coming water. The amount of this slip—that is, the amount of this "dead water"—is dependent on, and proportionate to, the number of revolutions and the inclination of the propeller blades and inversely proportional to the diameter of the screw.

Nature avoids these disadvantages through the use of the vibratory principles of propulsion. Nature takes care to have large and slowly moving surfaces that remain in constant touch with the fluid, so that no slip need



All sketches by the author

FISHTAIL BOAT-DRIVING MECHANISM

Vibrating fishtails made of tempered flexible steel attached to boats, the upper one being oscillated by an engine and the lower one by foot power, to propel the boats speedily forward

occur. The fish tail shows the same characteristic for all kinds of fish. Its slow, swinging motion gives the oncoming water sufficient time to follow the pressure of the tail. The swinging of the tail produces very little motion of the surrounding water. The propelling action consists practically of a sliding on an inclined plane, the direction of which is continually changed, but the resultant axis of which lies in the direction of the desired motion. In the case of propulsion by means of a screw-propeller, the water is not only pushed backwards, but is also given a rotary movement, which latter is of no use whatsoever for the propulsion of the vehicle.

A FURTHER advantage of the swinging or vibratory motion lies in the possibility of using the resonance of vibration for connecting the swinging motions of several individuals or mechanisms. Through the oscillating movement of a fish, a vibration is pro-

keep their wings tuned in to the exciting wave of the stronger ones.

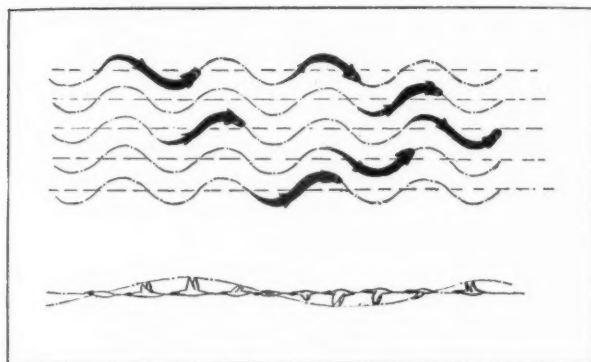
A similar phenomenon can be noticed in connection with the motion of large schools of fishes. If we regard, for instance, the motion of a number of minnows, we perceive that they all continuously perform exactly the same oscillatory motions and that these motions are tuned in to the same wave period and amplitude. Thus the individual fishes help each other and distribute the total energy of the forward swing to all members of the school.

As an example of the remarkable amount of energy which can be made available through vibratory motion, there is the trout which is capable of mounting the most rapidly flowing streams and can even negotiate whirlpools and waterfalls. By means of a whip of its tail, the trout jumps from the quickly moving waters over stones and other obstructions. A mechanical vessel with screw-propeller

however, to remember in this connection the fact that the almost incredible performances of half-starved wild geese and ducks in winter can only be explained through their efficient use of vibratory motion.

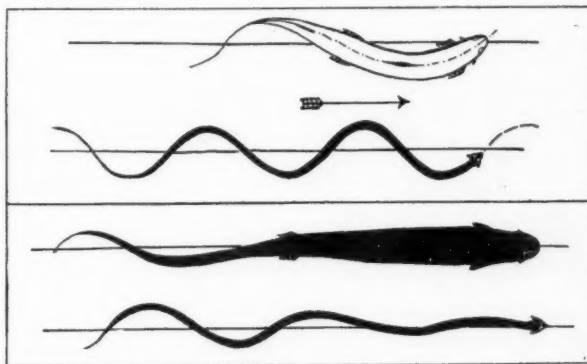
IT will be technically difficult and not always advisable to imitate the motions of living creatures, but the above mentioned phenomena are so striking that the modern engineer cannot pass them by unnoticed. We may call the past century the age of rotation. There are many signs which seem to indicate that the coming age will make use of vibration for propulsion in a much higher degree than has been done thus far. And in developing and perfecting the mechanism of vibration, modern engineering will have to profit by the creations of Nature, our most perfect master.

In consideration of the foregoing observations of which the German engineer, Hans Schramm, has made a



VIBRATION AMONG FISH AND BIRDS

A school of fish and a flock of migratory birds as they appear when traveling long distances, showing their relative positions



SPEEDING AND WANDERING

Above are shown the body movements of a fish and an eel while traveling at high speed and below, their movements when roaming

duced in the fluid, the length of period and amplitude of which is dependent on the specific swing of the body of the fish. This wave moves throughout the field of excitation in the water with its specific velocity and attempts to produce vibration of the same period and amplitude in other fish bodies capable of vibration within its reach. Let us assume that such a body itself starts a swinging motion which corresponds to the exciting wave; that is, let us assume that this second body will "tune in" on this wave. Then it receives from the energy of the wave a driving motion without exerting any energy of its own. Mr. Schieferstein, well-known expert in the science of vibration, has made exceedingly interesting experiments with reference to the oscillating flight of birds, which experiments have definitely proved that it is possible for cranes flying together, to couple their energies in such a way as to carry along their weaker partners for long distances, if these weaker birds possess just enough strength to

would, if at all capable of performing such feats, require an exceedingly large amount of energy for the purpose.

The flying fish are another example of the high acceleration possible through vibratory motion. Through a whip of their tails these fishes throw themselves many feet above the surface of the ocean. It is a well-known fact that sharks and whales can attain remarkably high velocities. The speed of a whale hit by a harpoon easily exceeds the speed of the pursuing fishing steamer. Sharks and dolphins follow the modern ocean liners for days, apparently without tiring.

THE driving action of vibration can also be seen in groups of men skating in the Dutch fashion. Through the use of swinging motion these men can keep up high speeds over long distances without difficulty.

It is hardly necessary to go into detail in connection with the flight of birds, which resembles the motion of the fishes in many ways. It is well,

special study, he has constructed an experimental boat containing a motor-driven rotary device effecting a fish-like propulsion. This is possible by means of a flexible steel plate which is moved back and forth by an attached lever, the eccentric end of which is connected with the rotating wheel by an adjustable rod.

The same effect may be accomplished by human power. The oarsman is seated and both feet are attached to a foot-rest which operates left and right on a central pivot. By alternately pressing either side of the foot-rest which is connected to a similar lever on the stern of the boat by a cable on each side, the steel plate is thrown into wavelike motion, thus effecting the same result. A speed of seven miles per hour was obtained by this boat.

Did plants and mammals, even man himself, have their beginnings in Africa? A well-known scientist says "yes" in a forthcoming article.

Groupings in the Aviation Industry

Status at the Time of Going to Press

By ERNST and ERNST
Accountants and Auditors

AVIATION companies are merging so fast these days that it takes a score card to keep track of them. Groupings of today are realigned tomorrow. Independents this month become units of combinations next month. The year 1929 will go down in aviation history as the great initial scrambling period.

To the average man it may be useful to point out the main directions of the currents of consolidation. This must be done in a rather tentative and incomplete way, for the picture changes kaleidoscopically, and the lines of corporate influence drawing the groups together are complicated by interlocking directorates, personal affiliations of like-minded executives and other similarities of purpose, as well as by outright financial control. Subject to these qualifications, there are four main groups:

I. *United Aircraft and Transport Corp., or Boeing group.* This is often characterized as the "General Motors of the aviation industry," although other groups also may lay claim to the same designation. It was formed late in 1928, and was financed largely by the National City Co. It has the largest outstanding single issue of senior securities of any aviation company. All companies in the group are operated as a unit, although the competitive spirit is fostered to a certain extent, much as in the case of General Motors. It includes both manufacturing and operating companies, and the nucleus is the group of Boeing companies. The board of directors includes many leaders of the aviation and automobile industries. Some of the leading companies are:

Boeing Airplane and Transport Corp., whose subsidiaries are Boeing Airplane Co., manufacturers; Boeing Air Transport, Inc., which operates air-mail routes between Chicago and San Francisco; and Pacific Air Transport Co.

Pratt and Whitney Aircraft Co., manufacturers of "Wasp" and "Hornet" motors, a profitable company.

Chance Vought Corp., manufacturers. Hamilton Aero Manufacturing Co. and Hamilton Metalplane Co., manufacturers. Stout Air Lines, Inc., operating between Detroit, Chicago and Cleveland. The corporation also has an interest in the Maddux Lines.

II. *Curtiss, or Keys, group.* This represents greater diversity and larger capitalization than perhaps any other group, but it is not operated so closely

as a unit, the affiliation being due rather to the ownership of stock in various enterprises by associated individuals. Most companies are operated independently, and it seems to be the policy to encourage the organization of a large number of relatively small companies, each operating in its special field. The dominant figure in the group is C. M. Keys, who is president of Curtiss Aeroplane and Motor Co., and head of several others. Grouped around Keys are a number of men who control the policies of various concerns. Companies ordinarily assigned to the group include:

Curtiss Aeroplane and Motor Co. Curtiss Flying Service, which is sales agent for several companies. Curtiss-Robertson Airplane Mfg. Co. Curtiss Aero Export Co. Curtiss Assets Corp. Curtiss-Reid Airplane Co. of Montreal. Curtiss-Caproni Corp. Aviation Exploration Co. Sperry Gyroscope Co. North American Aviation, Inc., (investment trust).

Transcontinental Air Transport, in which the Pennsylvania Railroad also is interested, to combine rail-air passenger service from New York to the Pacific Coast.

The following companies do not have very close association in their manufacturing activities, but the Curtiss Flying Service holds exclusive sales contracts in this country for their products: Sikorsky Aviation Corp., Douglas Co., Cessna Airplane Co., Ireland Co., Command-Aire, Inc.

III. *Wright, or Hoyt, group.* This group is bound together mainly because Richard F. Hoyt is chairman of the board of each, and associated individuals control the policies, but the inter-relations are looser than for some other groups. Hoyt is a partner of Hayden, Stone & Co., through which the financing of the companies is arranged. The number of companies is smaller, and their size is larger than units of other groups. There is a parallel or common interest between this and the Curtiss-Keys group. Companies in the Wright-Hoyt group include:

Wright Aeronautical Corp. Keystone Aircraft Corp., and its Loening Division. Aviation Credit Corp., which finances time payments on airplanes and equipment. Travel Air Co. Moth Aircraft Corp. New York Air Terminals.

Aviation Corp. of the Americas, owning Pan-American Airways, which operates lines from the United States

to Latin America. This latter company also has connections with all other groups and with independent interests.

Hoyt and Keys groups are jointly interested in the National Aviation Corp., an investment trust, which has close relations with Aviation Securities Corp., Aviation Corp. of California, Aviation Securities of New England, and Aeronautical Industries. The two groups also are interested in Aviation Credit Corp., National Air Transport, Inc., (New York-Chicago-Dallas), Transcontinental Air Transport, New York Air Terminals, Stromberg Carburator Co., and others.

IV. *Aviation Corporation, or Harriman, group.* This is a large holding company, having also investment trust functions, recently organized with \$35,000,000 cash, for acquisition of well established aviation companies. It was backed by a group of financial and investment houses headed by W. A. Harriman and Co., and Lehman Bros. It also lays claim to being the future "General Motors" of the industry. Among its principal acquisitions to date are:

Fairchild Aviation Corp., which controls various subsidiaries of that name. Universal Aviation Corp., which controls Universal Air Lines, Inc., Robertson Aircraft Corp., Northern Air Lines, etc. Southern Air Transport, Inc. Roosevelt and Curtiss Field, Long Island.

Independents. More than 60 so-called independents are not included in the four groupings above. It is a question whether a fifth large group will be formed from the independents, or whether most of them will gravitate to the existing "big four."

Fokker Aircraft Corp. of America, which is closely associated with Western Air Express, constitutes one of the most important groups of the so-called independents. A few of the other independents are:

Great Lakes Aircraft Co., Glenn L. Martin Co., Buhl Aircraft Co., Warner Aircraft Engine Co., Pitcairn Aircraft, Inc., Stearman Aircraft Co., Stinson Aircraft Corp., Mahoney-Ryan Co., Lockheed Aircraft Co., Lincoln Aircraft Co., Consolidated Instrument Co., Claude Neon Lights, Bellanca Aircraft Co., American Eagle Aircraft Corp., Alexander Industries, Inc., Air Investors, Aero Supply Manufacturing Co., National Aircraft Materials, Swallow Airplane Co., United States Air Transport, Consolidated Aircraft, and Allied Aviation Corp.

Avocados—Alligator Pears

These Tropical "Fruits" May Become as Important as Oranges in Our Daily Diet When We Learn to Like Them

By GUY ELLIOTT MITCHELL

FLORIDA, the land of fruits and flowers, is fast attaining quantity production of the alligator pear, or avocado as it more properly should be called. Southern California is not behind in this respect. Thousands of acres in both states are bearing full crops of this singular fruit, which is in substance a vegetable, and is perhaps the most nutritious of any tree product.

Many have eaten avocados but do not like them at first. They are somewhat insipid and seem to lack flavor, even though they are nutritious. This probably has been the reaction of the large majority of those who have been introduced to the new delicacy. How is it, then, that practically every traveler returning from the tropics likes the avocado, and that everyone in the tropics eats it with relish? The answer probably lies in acquisition of taste. Did you like your first raw oyster, or your first olive? But oysters and olives are in demand.

The ordinary avocado somewhat resembles a large pear, although some varieties are perfectly round. Its size ranges from as big as a hen's egg to that of a large grape fruit. The tree is tropical or semi-tropical and will not stand a heavy frost, so the growth of the avocado will be limited to the lower fringe of the United States. We are indebted principally to Mexico, Central America and the West Indies for the avocado.

"Three or four tortillas, a good sized

avocado and a cup of coffee; it is a good meal," many well-to-do Mexicans or Guatemalans will say. The tortilla, as we know, is nothing more than a very thin cake made of cornmeal, and anywhere in Guatemala and in parts of Mexico you may see an Indian *cargador* making a meal from an avocado and these tortillas. Apparently this is a diet that the Indian finds sustaining under the most severe physical exercise, for the *cargador* frequently carries 150 pounds on his back and makes little of tramping 100 miles with this load in five or six days. The fats, the proteins, and the carbohydrates—all the food elements are found in the avocado that are in a mixed diet of beefsteak, bread, and butter.

BUT while the Indian usually eats his avocado straight, with perhaps only a little salt, this strength building food is just as available in the form of a delicate salad or any of the toothsome dishes in which the avocado is the *piece de resistance*. By many it is most relished with only the addition of salt, pepper, and a dash of vinegar or lemon juice, yet it blends admirably with other salad ingredients and with more staple foods. In Central America it is the custom to add cubes of the fruit to meat soups at the time of serving, and in the West Indies a delicious omelette is made by adding finely cut avocado in the same manner as we use cheese or tomato.

If this is all true, why has not the avocado come into general use in the United States as a food, since it has been known here for a dozen or more years? The answer is, first, that growers are always cautious about planting expensive orchards with a new fruit the reception of which by the public is somewhat uncertain, and second, that we already are blessed with a great many good things to eat in this country, and any new product is always slow to make its way and create a demand for itself.

The avocado is somewhat of a luxury at present but growers in California and Florida have gone through the dangerous stage of determining the best of the hundred or more varieties and are even now engaged in what may be termed quantity production, while on the other hand the public demand has so increased as to assure them a ready market for all they can produce, so that hundreds, even thousands of new orchards are being planted every

year. Soon the price will be commensurate with a modest purse.

The tree is a free bearer, and begins to fruit four or five years after planting. Allowing for all sorts of contingencies, avocados can be sold by the grower, it is stated, at five cents each or less, and still be highly profitable. The presi-



AVOCADO TREE

This huge specimen is growing near Momostenango, Guatemala. Note man standing at right of the trunk of the tree



GUATEMALAN AVOCADOS

These are of the largest variety yet found here, weighing two and a half pounds each

dent of the California Avocado Association states that he expects to see the avocado sold on the market for five cents. The different varieties come into bearing at different seasons so that even today it is possible to find ripe fruit in both California and Florida on almost any day in the year. The avocado is a good shipper and eventually it will be common on our fruit stands. And here is a point to note: The avocado should be eaten dead ripe as then it is at its best and one can more readily learn to like it.

A fair sized avocado weighing about a pound, according to the Department of Agriculture, has the equivalent in food units (calories) of six eggs, or a pound loaf of bread, or a good-sized broiled steak. As a fruit it stands in a class by itself, with a far higher caloric value than any other fresh fruit except the olive. Probably, however, it will always be considered a "fruit," for the flesh is soft, about the consistency of a dead ripe banana, and very smooth, melting, and custardy.



REPAIRING RAVAGES OF TIME

A general repair of the city wall has been going on for some time. Missing stones have been supplied; broken stones have been repaired and pointed up, and a pathway provided

Walking Around Jerusalem

The Ancient Walls of the City of David and Solomon Are Being Restored

By HAROLD J. SHEPSTONE, F.R.G.S.

BUILD thou the walls of Jerusalem," said the Psalmist, and these famous walls are actually in the hands of the builders. Shortly after the declaration of peace an influential body, known as the Pro-Jerusalem Society, was founded, whose aim is "to preserve the ancient monuments, encourage technical education, plant trees, and in general beautify the ancient and historic city of Jerusalem." It is an officially recognized body, and receives a grant of 10,000 dollars a year from the Palestine government. The whole of this sum, and also any other money that may be contributed by interested persons, is spent upon the actual work of preservation.

During the last few months it has devoted a great deal of attention to the walls of Jerusalem and it is now possible to walk around on them. What a world of romance these ancient walls record! They carry the mind back to the early days of Hebrew history, for it was David and Solomon who first enclosed Jerusalem by a wall. Nehemiah subsequently enlarged and extended them, and there they stood in all their glory at the time of Christ.

When Titus, the Roman general, destroyed Jerusalem in the year 70, he pulled down its old walls and laid the city in ruin. Then an entirely

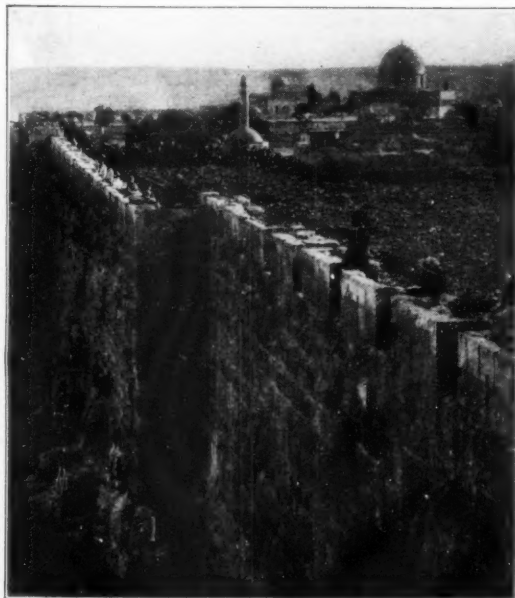
Roman city arose on the sacred sites only to be destroyed once more by the Persians. The present walls were built by Suleiman the Magnificent in 1536-42. This is attested by the numerous inscriptions found on the gates. According to local tradition it was the work of two brothers, who commenced at the Jaffa Gate in opposite directions, and never saw each other again for seven years, finally meeting at the St. Stephen's Gate, in the eastern wall, where they placed their marks—the lions. This hardly seems credible, but the East is as full of romantic stories as the "Arabian Nights."

THE circuit of the walls, which vary in height from 38 to 40 feet, is about three miles in length, enclosing about 200 acres—one sixth of its extent being devoted to the temple area, which contains 35 acres. The walls are graced with 34 towers and eight gates—one of which is permanently closed. The only gates of importance are the Jaffa

Gate, the Damascus Gate, and St. Stephen's Gate.

The question the layman naturally asks, is, do the present walls mark the boundary of the city of Christ's day? We know that the remains of the former walls were left as they had been thrown down, and that the same stones were built more or less on the same foundations. Here and there slight deviations were made but, generally speaking, the present wall stands in the line of its immediate predecessors. No regard was paid to the respective marks of former builders as is shown in the dressing of the stones. Hence we see the Byzantine above the Crusaders, and the stones of Christian masons resting on those of pagan Rome. It is only where foundation courses exist that we can see the different building epochs represented by their respective positions in the structure. And these are infallible proofs of their antiquity, just as much as the intermixture of stones shows the work of the latest builder.

WE know from excavations made by the Palestine Exploration Fund the course of the first wall built by David and Solomon, but one cannot be certain as to the course of the second wall which marked the boundary of the city in Christ's day. For instance, the Church of the Holy Sepulchre, which is said to mark the site of Christ's burial, lies within the present walls. Now Christ was buried "without the city walls," and many scholars place this portion of the north wall to the south of the church. The failure to determine the exact course of the second wall along this point leaves the problem of the site of



A POINT OF VANTAGE

Visitors looking from the north wall of Jerusalem. The dome of the mosque of Omar is at the right

the Holy Sepulchre an unsettled one. Evidently the Jerusalem of Biblical days was a small city, about 200 acres in area. Yet it contained Solomon's magnificent temple, the King's palace, other large buildings, and the dwellings of its inhabitants.

Until just about a century ago there were no buildings beyond the city walls, and at sun-down (as also at noon, during the Mohammedan prayers, on Friday) the gates were all closed, and it was almost all a man's life was worth to arrive after the gates were closed. We know how Christ likens the entrance into the Kingdom to a man passing through the straight but narrow gates of a city. He had often seen the people at sunset hurrying to the gates and passing through their narrow entrances with their twists and turns, into the city.

WHEN the Jews began to return to the city of their forefathers, and Jerusalem could not hold them, people ventured to build outside, first with a good deal of apprehension and considerable danger, but later, in larger numbers and with considerable fearlessness. Here it is interesting to note that the line of improvement has followed closely the descriptions of the re-building of Jerusalem given in Jeremiah XXXI, 38 to end, and in Zachariah XIV. Then one of the gates was left open all night, and presently a second, and so on until all were never closed. In fact they now have no doors to close.

Then came the building of carriage roads to Jaffa, Bethlehem, Hebron, Jericho, Nablus, and Ain Karim (the reputed birthplace of St. John), when it was soon discovered that the existing



TRULY ORIENTAL

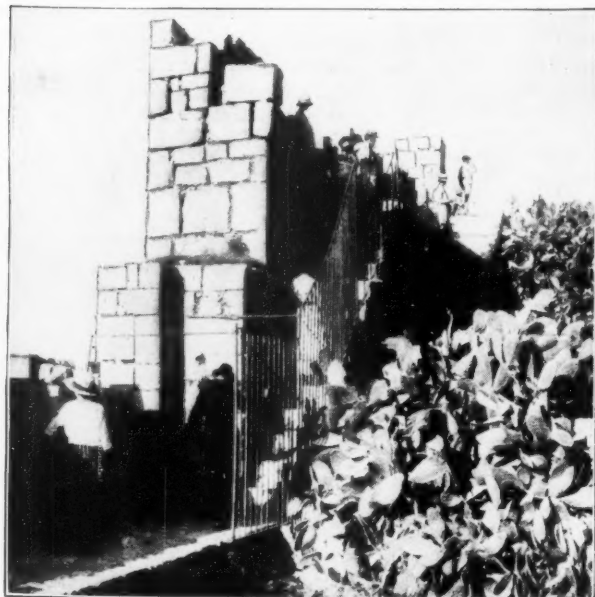
This is the Jaffa gate as restored. Existing gateways had to be widened for modern traffic

gateways were far too narrow for the increasing traffic. Two of them were accordingly taken down, and a portion of the wall cut away, giving sufficient space for a carriage to pass straight in instead of having to turn.

During the Turkish régime nothing was done in the way of preserving the walls. As a result they fell into a very dilapidated condition, more particularly with regard to the top stones, many of which were carried away. Besides, each land owner within the walls blocked the walls at both extremes of his property.

Through the efforts of the Pro-Jerusalem Society the missing stones have been restored, the rubbish and growth which covered certain portions

of the walls have been removed, the obstructions that prevented a continuous path have been taken down, and here and there, in dangerous parts, iron rails and bannisters have been provided. To-day, anyone, on paying the fee of half a dollar, can walk from the Citadel to the Mosque enclosure, either way. Climbing the wall by the Citadel, near the Jaffa Gate, you can take the eastern walk to the mosque or temple enclosure, while if you walk the other way to the west you pass about by the Jaffa Gate, Damascus Gate, Herod's and St. Stephen's Gates to the other extremity of the mosque enclosure. Thus are the walls of the Holy City being preserved and protected for posterity.



WALK IN SAFETY

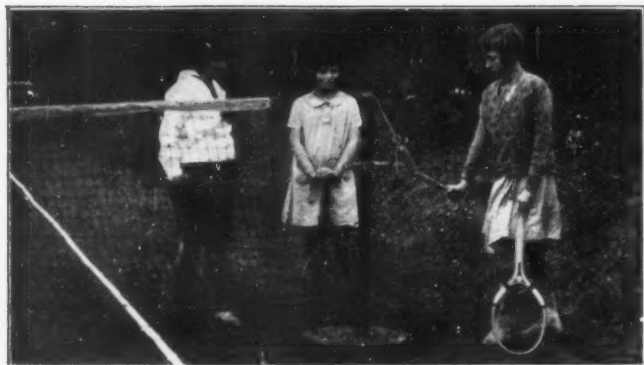
Steps and iron railings make a circuit of the walls a safe journey. Tourists are overlooking Jerusalem from this advantageous position



WALLS OF JERUSALEM

These walls are forty feet high and an entire circuit of the ancient Holy City can now be made along the pathway on top of them

Inventions New and Interesting



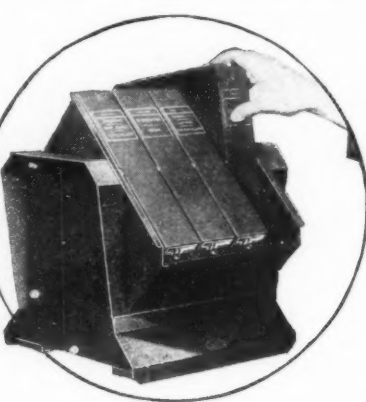
SIMPLE TIGHTENER FOR TENNIS NETS

Eliminating the slack and raising the tennis net to the proper height is facilitated by this device, which operates so easily that children can tighten a net easily and properly. The pole has no gear ratchets.—*M. R. Lane & Sons, Ardmore, Pennsylvania*



BABY ROADSTER

Everything but a rumble seat is provided on this adjustable perambulator for fresh air babies. It can be pushed or pulled by an attendant, or operated by the baby.—*The W. J. Baker Co., Newport, Kentucky.*



TELEPHONE BOOK RACK

These steel-backed cloth-bound binders made to hold four telephone directories fit into a special rack which is equipped with a pivot. Each binder swings in a semi-circle, resting on the rack when it is opened.—*Pressed & Welded Steel Products Company, 11th St. at 40th Avenue, Long Island City, New York.*

◀ FLEXIBLE RUBBER STAMP

The handle of this rubber stamp is attached to a Bakelite base by a small section of rubber which provides sufficient play to assure a clean impression despite the angle at which the pressure is applied.—*Lake Manufacturing Co., Dallas, Texas*

CURE FOR COLD FEET ➤

Just enough heat to warm the feet, without causing them to become too hot, is provided by this electric warmer. The only perishable part is a small resistance coil which will last for several years.—*Simmons Research Corporation, Ostend and Denver Streets, Baltimore, Maryland*



DOUBLE EAR PHONE

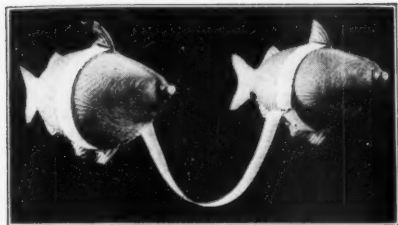
Sometimes both ears are needed in conversing over the telephone. This easily attachable device provides a receiver for both ears, excludes exterior noises, or can be used by two listeners at once. It is non-electrical.—*American Earphone Company, Inc., 10 East 43rd Street, New York City*



STEEL-WOOL POLISHER

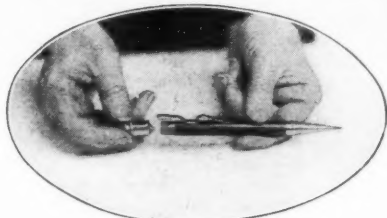
Cloth covered steel wool brushes make convenient polishing pads. They are treated with a chemical to resist rust, and protect the hands while scouring utensils.—*Whiskette Manufacturing Co., Terre Hill, Pa.*





NOVEL WATER WINGS

These queer-looking "fish" have been harnessed to assist would-be swimmers. They can be inflated like the usual water wings, and will support a grown person.—*Kleinert Rubber Co., 485 Fifth Avenue, New York*



PENCIL-LIGHTER

Now the combiners have wedded the mechanical pencil to the cigarette lighter. The pencil-lighter has the customary muzzle-loading features for the lead.—*Lyco Company, 2633 W. Canton Street, Chicago, Illinois*



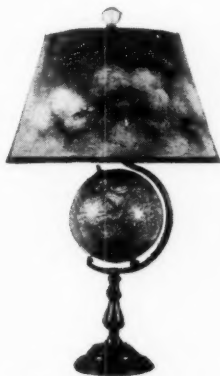
INDOOR GOLF GAME

Lady Luck now plays golf, with inlaid dice and a score card for keeping track of the strokes of the players. "Golf" put-and-take tops with the same characteristic markings are made by the same firm.—*Elkloid Company, Providence, R. I.*



FLOOR CONNECTIONS FOR ELECTRICAL DEVICES

For desk lamps, adding machines, telephones, annunciators, and other electrical fittings indispensable to the modern office, these little floor plugs have been designed. The outlet in the foreground is fitted with a two-way connection for either high or low tension applications. The fittings and floor connections are made of brass.—*Russell & Stoll Company, 53 Rose Street, New York City, N. Y.*



LIGHTING THE WORLD

Lindbergh probably inspired this combination globe and lamp. The parchment shade is decorated with clouds, stars, and an airplane in flight. The globe revolves freely, and is eight inches in diameter.—*Heather's, 411 Fifth Avenue, New York City, N. Y.*



ELECTRIC INCENSE BURNER

To use this unusual incense burner, one merely drops a piece of incense in the top, replaces the lid, turns on the current, then turns off the electricity when the incense is ignited.—*Electra Cense Burner Company, 2314 Keyes Avenue, Madison, Wisconsin*



THREE PIECE ROASTER PREVENTS BURNING

The bottom pan is filled with water, just below the perforated tray in which the roast is placed; sufficient steam is generated to keep the roast juicy without basting. The meat cannot burn.—*Geuder, Paeschke & Frey Company, St. Paul Avenue and 15th Street, Milwaukee, Wisconsin*



CIGARETTE CONTAINER AND ASH TRAY

By pushing the lever at the base, a cigarette is ejected into the hopper at the right. Another push replaces it, if it does not happen to be the desired kind. The tray rests in the top of the container, and is removable.—*The Keller Company, Inc., Brokerage Building, St. Paul, Minn.*

The Scientific American Digest

Newest Developments in Science, Industry, and Engineering

Railroad Travel De Luxe

WHEN the train pulls out of the terminal and your luggage is stowed away, an anticipatory smile comes over your face as you head for the lounge car. You've been looking forward to this moment for days, perhaps, for your trip is arranged over the Burlington Route and you've heard of the splendid cars, devoted entirely to lounging purposes and free for all Pullman passengers, now carried on crack trains of that road.

Arriving in the main lounge, you make yourself at home but, what is more, you actually feel at home. The beautiful chairs and divans you find are as pleasantly comfortable as they are handsome. You find that they can be shifted around, too, if you are visiting with a friend or if the view out-of-doors is particularly attractive. When you entered the car, you noticed the unobtrusive richness of the decorations; the fine brown of the walnut paneling that reaches to the ceiling is a perfect background for the greens and the gray-greens of the chairs, carpet, and ceiling.

A smoke would taste good? Of course. About you, you find plenty of smoking stands—and little electric cigar lighters. They work! But where does all the smoke go? Others are smoking yet the air is clean and fresh. Oh yes, those exhaust fans near the ceiling and the regular fans must do the trick.

You are happily surprised to learn that you may have buffet service at your chair merely by touching a button, and that you

you were in your own club at home. You resolve to tell others of this traveling "living room" which, you learn, is the result of many months of painstaking work on the part of Burlington and Pullman engineers.

Just What Is a Robot?

ONE of our correspondents in the Department of the Interior, Ottawa, Canada, proposed a curious question which concerned the derivation of the word "robot." We consulted all the dictionaries in our library and prosecuted inquiries wherever we thought they might prove fruitful. We finally wrote to Mr. R. J. Wensley, who is the creator of the Westinghouse electric robot. Mr. Wensley wrote us as follows:

... "I am informed by a student in our Apprentice Course, who comes from Czechoslovakia, that the word is a Czechish word which, literally translated, means a very hard working man doing heavy manual labor. The word came into use because of its appearance in the Theater Guild Play 'R.U.R.' by a Czechish writer, Capek."

The above information was relayed to our correspondent, who in turn gave us some additional information of which the following is an excerpt:

... "With reference to your reply, it quite disposes of my previous idea that the word is of modern and synthetic origin. I would have answered you

in other than Slavic languages, because a very old dictionary which we unearthed gives Robat, Robath, Roboth, Robold, Robald, and Robelt as proper names, each and all meaning worker."

Power Machine Gives Artificial Respiration

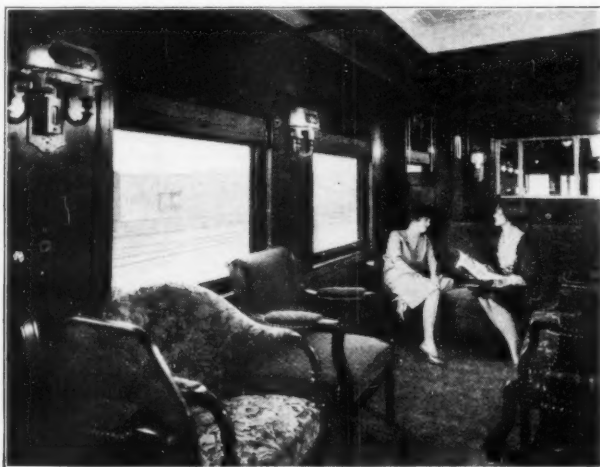
VICTIMS of accidents interfering with breathing and circulation can now be resuscitated by a respirator machine operated continuously by electricity, just installed in Bellevue Hospital, New York, through the courtesy of the Department of Hospitals. It is introduced as the first satisfactory appliance for administering artificial respiration over long periods. It could have been employed, for instance, to take the place of the 20 policemen, who recently worked in relays for five days to restore an unconscious woman. Its range covers asphyxia due to electric shock, concussion, gas poisoning, smoke, and drowning.

This mechanical respirator was perfected after nearly two years of experiments by its designers, Philip Drinker and Louis A. Shaw, of the School of Public Health, Harvard University, and constructed at the request of the Committee on Resuscitation of the gas and electric companies affiliated with the Consolidated Gas Company of New York City.

The appliance is a heavy metal tank equipped with various accessories. The tank itself is 6 feet in length and about



Interior of one of the lounge cars on the Burlington Route, product of Burlington and Pullman engineers



A corner of the ladies' lounge in the car shown at the left. Its main features are spaciousness and comfort

can enjoy the view from an entirely new kind of observation platform—a sun parlor where cinders can't reach you but some of the healthful ultra-violet rays of the sun can come through the Vita-glass that surrounds it.

People about you are playing cards, others are writing at tables supplied for the purpose, others are reading; and you settle back comfortably in a deep-cushioned, leather-upholstered chair as though

sooner, but for the fact that, based on the start you give me, I have been checking the matter through a little further with the help of two or three men in Government service here who are of Slavic birth and education. They all confirm the information that you obtained, the word or closely allied derivatives being found in both Polish and Czech as meaning work, worker, or manual laborer. In fact it is also found

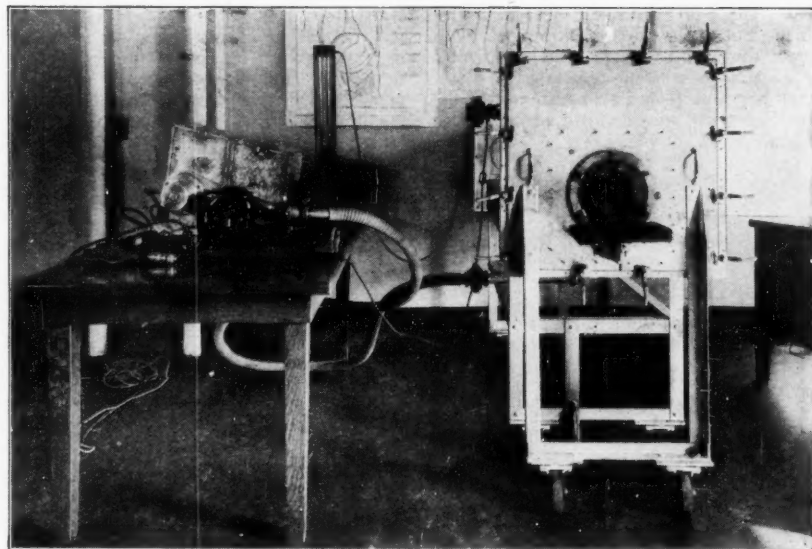
2½ feet in width and depth, and can accommodate the body of a tall man of large girth. Its plates are electrically welded so that every joint is air tight. When the machine is required for a patient the front end is removed simply by undoing a set of hasps. From the interior, drawer-like, is slid a bed, with steel spring mattress, upon which the body of the sufferer is placed, after which the couch is pushed back into the steel shell. The head of the patient is

thrust through a highly elastic rubber collar, securely clamped to a circular opening in the front panel. This collar yields to motions of the throat and yet fits snugly enough to prevent the entrance of outside air. The head, sticking out from the end, is placed upon a support bolted like a shelf to the front and resembling the rest of a dentist's or barber's chair. The end panel is then clamped or battened down by the hasps, the union being made air tight by gaskets or washers of leather. The body is thus in a container much like a compressed air chamber, or a diving bell.

After everything is hermetically sealed, air under slight pressure is alternately pumped in and drawn out of the box in imitation of the act of breathing. The incoming current bears down on the chest and abdomen of the patient and causes him to exhale. When suction is applied the patient's lungs inflate as the outside atmosphere rushes in through his exposed nose and mouth.

Months of experimenting were spent in producing a regular and rhythmic respiration time to the age and strength of the patient. This is accomplished by a device called an alternator, an electrically controlled valve, one side of which is solid, and the other so meshed as to admit outside atmosphere. The air is circulated by blowers, of the type used for vacuum cleaners, which act as pumps. After passing through the blowers it comes in contact with the alternator valve which sends air currents through two branches of a "Y" tube. In general, 15 breaths a minute are prescribed for adults and children over five years of age, and from 22 to 25 respirations for babies. The patient thus can be made to breathe deeply or shallowly and as quickly or as slowly as the attending physician deems best. The machine is often tested by watching the pulsations of a soft rubber diaphragm substituted for the collar.

There is also a water gage which guides the operator in regulating the device. If air pressure gets too heavy, the gage or manometer overflows—safety-valve wise—and the pressure is automatically lightened. Through a rubber lock-like device in the side of the tank, the tube of a blood pressure testing instrument is led. A supplemental steel container can also be placed over the patient's head into which oxygen or mixed gases can be forced for inhalation, if required.



The power machine that gives artificial respiration. Note the hole through which patient's head protrudes during treatment; also the motor and air hose

If able to receive nourishment, the patient can be fed, and he can also talk while artificial respiration is in progress, or fall into restful sleep. The inventors say this is probably not true of any other methods.

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Electric Heat in Fig Packing

ALTHOUGH classed as sub-tropical fruit, figs grow naturally in a wide latitude ranging from the tropics to warmer climes of the temperate zones, more than one hundred varieties being listed. The dried figs of commerce, coming principally from the Mediterranean countries and California, were the only form in which this delicious fruit was shipped until a relatively short time ago when preserved figs were introduced.

Early in the history of California fruit-canning, efforts were made to preserve and can figs but with little success. Not until the Kadota fig, really the Dattato fig of Italy, came into bearing in a small way about 10 years ago, did the canners and preservers meet with much success in canning and preserving this fruit.

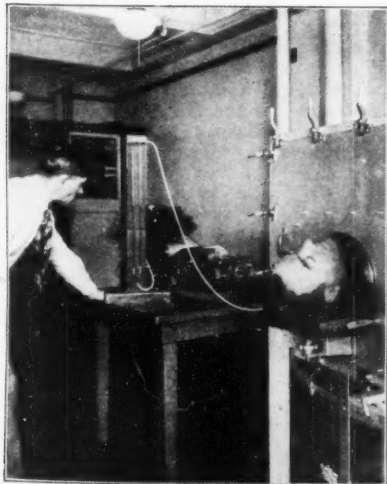
The Kadota fig seems to be particularly adapted to canning. Its seeds are very small and scarcely noticeable in the eating, while the skin is just sufficiently firm to hold the fig together during the process of canning. The color appeals to the eye and the flavor is always uniform and sweet.

The Kadota fig thrives best in the San Joaquin Valley where there are now approximately 3000 acres in bearing. New acreages are coming into bearing each year. The trees are planted about 75 to the acre and are rigorously pruned back each year, the choicest fruit appearing on the new wood each summer. Harvesting begins about August 1 and ends about October 15. In order to get the fruit at its best the orchards are generally picked two or three times a week, and daily during the period of heaviest production.

The old-fashioned preserving method of boiling the fruit and sugar in open copper or aluminum kettles until cooked, then cooling the fruit to be placed in the package, later followed by reheating, sealing, and final heating for sterilization, resulted in a product too expensive for general use. There was no possibility of making this a staple every-day food at popular prices. The need of a more economical and efficient method of packing was seen several years ago by the Beckwith Company of Reedley, California, where there has been developed a method of continuous semi-automatic cooking using electricity as a heating agent. Figs arriving at the Beckwith plant are processed and sealed in containers within a few hours without any preservative other than pure cane sugar.

On arriving at the plant the first step is the sorting which is done by placing the fruit in a single layer on a wide moving belt. All fruit is clearly visible to the inspectors who remove the over-ripe, green, or imperfect fruit not up to requirements in quality. The perfect fruit then passes along on the belt under intense sprays of water where it is thoroughly washed. Rolling from the belt, the figs pass through a grader which separates the fruit into six sizes. Dropping from the grader the various sized figs roll into spotless re-tinned screen bottom containers which drain all water from them.

Poured into cooking pans in evenly measured batches of 30 pounds, the figs are placed on an electric heating table where they are moved forward at short intervals. Within a few feet of travel above the intense heat the figs are soon boiling. Sugar is then added and the heat tempered some-



While a doctor watches the pressure of air that is being supplied, a victim of asphyxiation is being treated with the new equipment

Besides watching the face of the patient for variations in color of the skin and lips, to guide him in his treatment, the doctor or nurse on duty can also observe the body for symptoms by looking through a glass covered porthole in the top of the machine. As the glass is of quartz composition, X-ray photographs can be taken through it.

what, the figs continuing their travel on to the end of the apparatus for a period of about 60 minutes, when they are finished.

Without leaving the apparatus, the pans pass between rows of operators who lift the figs with spoons into various sized, washed, and sterilized cans, leaving the

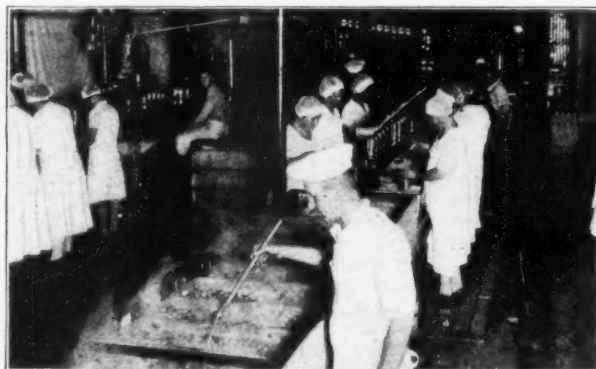
read more easily the stone tablets and papyrus rolls. This is indicated by pieces of round glass from Egypt, one of which, now in the Ashmolean collection, may date back to the first dynasty of Egypt, or about 3500 B.C. That magnifying glasses were known in the famous civilization of

The gas fire provides a means of gradual heating of the engine which could not be had under the old system of firing, thus bringing up steam at any desired time. This is very much easier on the engine itself and its mechanical equipment.

Some of the other advantages of using



Figs as they come from the orchards are passed through this machine for inspection, sorting, and washing



The finishing touches in the preparation of canned figs. Here enough sugar is added to bring out the flavor

syrup in which the figs have been cooked for further concentration. The filled cans travel along a conveyor to a syrumping machine where the treated concentrated syrup is added. The cans are then sealed without solder in a seaming machine and pass directly into a rotary sterilizing apparatus. The temperature of the cans is brought down to normal in cold water, when they are ready to be labeled and cased for shipping. The only time these figs are touched by human hands is when they are picked from the tree.

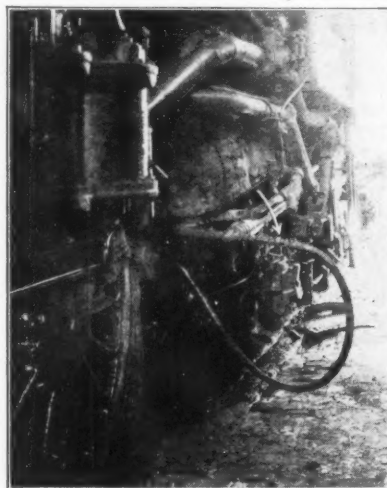
The intense steady heat given off by the electric cooking tables makes possible this continuous method of cooking. Steam customarily used in heating the jackets of the old style stationary kettles cannot be employed in a moving apparatus nor would it give sufficient heat in limited time to make continuous operation possible. The close control possible in electric heat is another element in its favor. The perfect cooking which brings out the delicate flavor of the figs packed by this company is made possible by electric heat.

In the Beckwith plant are four electric tables each containing 38 three-quarter-inch Glowbars 20 inches long, of initial rating of 3.3 kilowatts each, making a total of 125.4 kilowatts for each table. Two 110-volt 38-32 ampere Glowbars are connected in series on a 220-volt circuit. The heating area of each table is 75 square feet providing a capacity of 1000 to 1200 pounds of fruit per hour.

The conservation of heat through adequate insulation is a feature of the installation. By means of a scientifically worked out plan, heat losses are reduced to a low minimum. The floors of the cooking chambers are covered with several layers of insulating materials and the side walls are covered with asbestos. Because the heat is free from fumes or gases, it is possible to direct practically all heat generated by the Glowbars directly into the pans where it is active in cooking.

Magnifying Glasses Helped Eyes of Ancient Egyptians

WHEN the eyesight of Egypt's wise men grew feeble from study they used magnifying glasses to enable them to



The gas connection utilized in gas-firing locomotives. The gas supply was on the far side of the engine in this case; therefore the hose was passed between wheels. Hitherto the oil was broken up by steam

Crete, about 1200 B.C., had been shown by two crystal lenses discovered in the Cretan ruins.—*Science Service.*

Gas-Firing a Locomotive

A SAVING of 24,000 dollars yearly is now being made by the Southern Pacific Railroad Company by the use of natural gas for firing locomotives in getting up steam in the Los Angeles shops. As far as is known, this had never been done before.

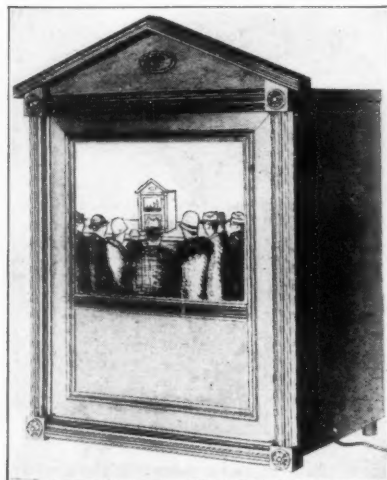
After a run, a locomotive is placed in the round house, thoroughly inspected, and prepared for its next trip. Prior to the use of gas, steam had to be taken from the boiler plant to break up the oil before the engine could be fired when being prepared for service. With the use of gas, however, all that needs to be done is to attach a gas line from the shop mains to the oil burner, apply a torch, and the fire is ready. The gas flows through the regular oil burner, and uses it as a gas burner.

gas for this process are the fact that the engines can be fired in much less time than formerly; the smoke nuisance is avoided; the fire hazard from oil drippings is done away with; and finally, there is the financial saving of more than 24,000 dollars a year.

The Los Angeles round house will hold 60 engines at one time. Approximately 10,000 cubic feet of gas an hour is used to get up steam for one engine, and often from four to six engines are fired in an hour.

Continuous Photographic Display

A NOVEL projector of "still" photographs for window display purposes has recently been placed on the market. The illustrations in these columns show a front view of the device and also the interior structure. A standard 35-millimeter "still" film is employed and the mechanism operates the film automatically after it is once started. Upon the completion of one showing of the strip, the operation repeats itself without any attention from an oper-

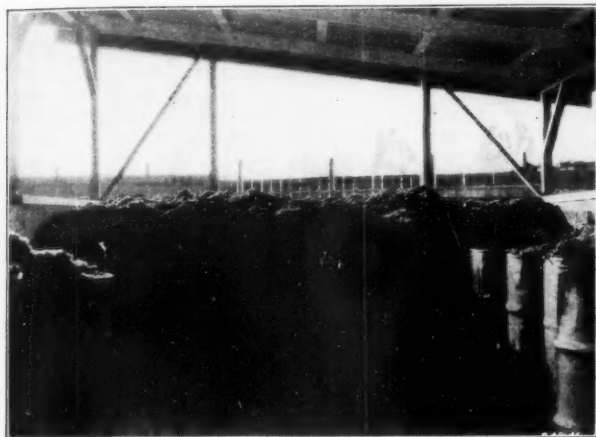


The automatic advertising photograph display machine. Crowds before store windows containing this machine evidence the satisfactory nature of such advertising

ator. The pictures projected on the screen are $9\frac{1}{4}$ inches by 12 inches in size, and the projection intervals may be varied from seven to 12 seconds according to the sub-

table, forked over, and that portion of the waste unfit for reclamation set to one side to be burned up. Good judgment is necessary at this point, on the part of the opera-

there again placed in the power press and any remaining oil removed. The waste is then pulled apart by hand to give it resiliency and placed in a saturating vat



This illustration, while not intriguing perhaps, shows the sorting table, the first step in waste reclamation



To the left is the tumbler (second operation); and in proper sequence: washing vat, press, and saturating vat

ject matter being displayed. The pictures change silently and automatically, the entire series being repeated without interruption.

Reclamation of Waste Nets Large Saving

ENGINEERS of the Southern Pacific Company have perfected a series of devices for the reclamation of journal waste, which permits the waste to be used over and over again. Use of these devices resulted in the saving of \$71,441.68 during the first 11 months of 1928. The equipment is installed in a specially-built structure which is fireproof and also equipped with a system of steam pipes for smothering flames in case any waste should become ignited.

All old waste, both cotton and wool, accumulated at the time of re-packing journals, is placed in special metal-covered containers, and shipped to the reclamation plant. There it is dumped onto a sorting

tor, in sorting out the short-fibered and badly-matted waste for destruction. He also takes out any metal or other foreign matter that he sees at this time.

The waste left for reclamation after the operation just described is then picked over by hand, the waste pulled apart, and foreign matter discarded. This waste is then placed in a power press and the old oil pressed out. After being removed from this press, the waste is placed in a tumbler where the short-fibered waste, as well as any remaining foreign matter is removed. A stream of compressed air is blown through the waste as the material is being stirred about within the tumbler. This operation blows away practically all short-fibered waste and also removes moisture. The waste is next worked over a carding rack by hand.

The waste is then placed in a washing vat filled with wiping oil where it remains for at least 30 minutes, being worked over with a fork during this period. The waste is then removed to draining traps and from

where it remains for at least two hours. The reclaimed waste is finally removed to the drainage tank and left to drain for six hours or more. It is now ready to be used again in re-packing journals.

Oat Hulls Are Burned in Powdered Coal Furnaces

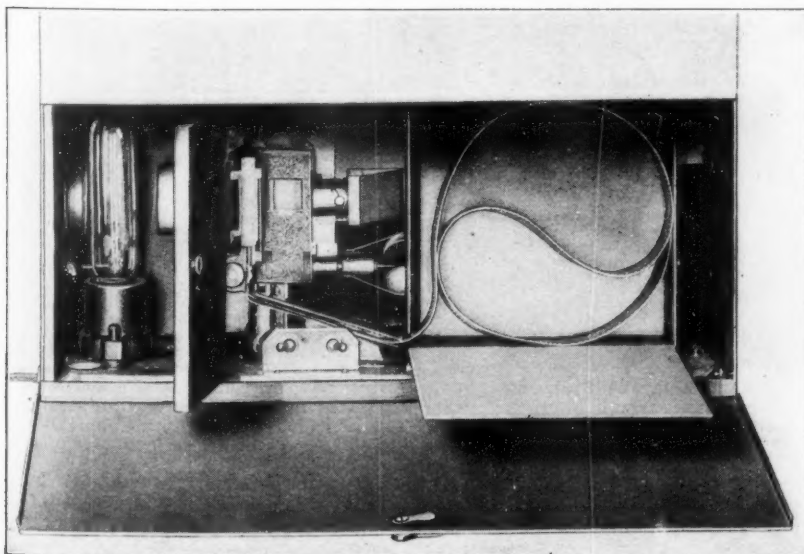
ENGINEERS, most people have decided, can solve any problem that modern civilization may present. In a recent issue of *Power*, Mr. C. J. Herbeck, Chief Engineer at the Cedar Rapids Plant of the Iowa Railway and Light Corporation, tells how a chance discovery helped the engineers to figure out that the oat hulls and other refuse left as by-products from the preparation of oatmeal can be effectively utilized by burning in powdered coal furnaces.

At Cedar Rapids, Iowa, the Quaker Oat Company has a large plant where large amounts of oat hulls are available as a waste from the manufacture of oatmeal. It was decided to dispose of the oat hulls by burning them in the power station of the Iowa Railway and Electric Light Corporation, which is only about 400 yards from the oatmeal plant.

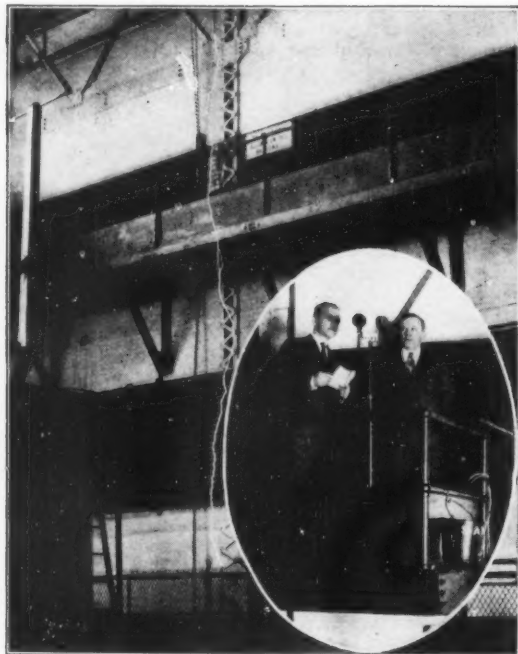
An eight-inch underground pipe, equipped with a pneumatic blower, transported the hulls to the coal bins at the power station. In order to discover the most efficient means of combustion, a wide variety of methods was tried. Chain grates proved to be too slow. Underfeed stokers with the original drive, would not accommodate the required volume of hulls, so the original drive was disconnected and the plungers were connected directly with the crankshaft. But the result was no more favorable than with the chain grate, and particles of unburned hulls passed out of the stack and aroused criticism from the city.

About that time, it was noticed that during the time the soot blowers were in operation, practically all the smoke from the burning hulls was eliminated. This led to experiments with forced draft over the fire, and it was found that burning the hulls in suspension is much the better way.

Using two boilers equipped for powdered coal, a flexible arrangement was devised



The mechanism of the continuous photographic display machine. A standard 35-millimeter "still" film is shown a picture at a time, over and over



Crashes of artificial thunder, produced by the new 5,000,000-volt lightning generator of the General Electric Company, at Pittsfield, Massachusetts, were to be heard recently during a talk on lightning delivered by F. W. Peek, Jr., consulting engineer of the above named company, from station WGY. The accompanying photograph shows one of the high-voltage sparks jumping a wide needle gap in the laboratory, while in the inset are Kolin Hager, broadcast announcer of WGY, at left, and F. W. Peek, Jr. The General Electric Company is actively engaged in studying lightning to determine its characteristics—as much as possible—with the purpose of learning how to protect transmission lines more efficiently

regenerating such organs as the cutting deprived them of. If one of these slices is split in two, or even in four, each of the bits will still organize itself into a small but perfect worm.

Queer things begin to happen if a transverse slice is partly split lengthwise, leaving the pieces attached to each other by one edge. If the free ends are toward what was the head of the original worm each piece will develop a new head, but all of the pieces will keep the same tail. If the free ends are towards the tail, the new worm will have one head and several bodies. The urge towards normalcy remains strong, however, and as a rule the partly attached worms with independent heads will pull loose and set up in business, each for itself, while the one-headed, many-bodied individuals either separate in like manner or else absorb the supernumerary bodies into one dominant individual.—*Science Service.*

Enlargements From Amateur "Movies"

A RECENT issue of *Filmo Topics*, the Bell & Howell Company publication for amateur "movie" makers, announced a new enlarging device which gives promise of answering the oft-repeated question—"How can I get good enlargements from my 16-millimeter films."

The device, which is used in conjunction with any Filmo projector, produces very creditable enlarged negatives, two and one-quarter by three and one-quarter inches in size, with a minimum of effort on the part of the operator. It may be used under any light, natural or artificial. No dark-room is necessary.

The Filmo enlarger consists of a tapered box at the small end of which a special fixed-focus enlarging lens is mounted. The regular projection lens is removed and the enlarger is slipped onto the projector in such a way that the enlarging lens replaces the regular lens. A bayonet-like shaft on the enlarger comes into firm contact

whereby either hulls or powdered coal can be used, without taking the boilers out of service for the change-over.

During certain seasons other uses are found for the oat hulls, but there is a quantity of other refuse that must be disposed of. By erecting a partition in the coal bunkers, this refuse can be stored conveniently, and later fed through the individual feeders to be burned with the powdered coal. By adjusting the feeder, it is easy to control the amount of refuse that can be burned without affecting the boiler.

Corncobs Yield Intense New Sweet

A COMPOUND about 300 times as sweet as sugar has been evolved from corncobs by Dr. Henry Gilman and A. P. Hewlett, organic chemists at Iowa State College. Should this new compound prove to be harmless to the body it may become valuable as a sweetening for food for diabetic patients who cannot use sugar. The work is in a preliminary stage and the value of the new compound is undetermined, according to Dr. Gilman, who is in charge of organic chemistry at Iowa State College.

Perhaps perfume bottles and household extract bottles in the future will be filled with compounds derived from corncobs. During the past year Dr. Gilman and George Wright have produced from the corncob many new compounds which may prove valuable as perfumes and food flavors. Although physiological reactions of the new compounds have not been thoroughly determined, early tests have been most promising.

Most of the new compounds possess fruity, pleasant odors, while one especially promising compound may possibly be used for maple or walnut flavoring or as an added flavoring for coffee. Raisin, caraway, and apple flavors, also have been produced. One compound, a perfume possibility, has an odor resembling cham-paca, a heavy, fragrant perfume made from the flowers of an East Indian tree, while another compound these chemists have evolved has the fragrance of roses.

The work with corncobs is a part of the work with agricultural wastes being done at Iowa State College. At a recent exposition in New York a local anesthetic, the hydrochloride of diethylaminoethyl-beta-furylacrylate, developed by Dr. Gilman and associates, was shown. This anesthetic, prepared from corncob material, is approximately as effective as novocaine.—*Science Service.*

Minced Sea-worm Turns into Family

CUT most animals up and they simply die. Cut up lineus, a sea-worm common along the Atlantic coast, and it merely turns into a family of little lineuses. How



Five-ton cable reel trailer built by the Highway Trailer Company of Edgerton, Wisconsin. The drum on the front of tractor pulls in underground steel-armored cable and also loads reels on trailer by means of a cable through the "super-structure" pulley. This equipment is useful in rugged sections

it survives this terrible surgery was told before the National Academy of Sciences recently by Professor W. R. Coe, of Yale University.

Slices cut clear across the body, at any place back of the creature's brain, turn into little replicas of the original worm,

with the projector aperture plate and automatically focuses the enlarging lens. A set screw locks the entire unit firmly into place.

A film pack adapter, supplied with the enlarger, is loaded with a pack and slipped into place at the large end of the tapered

box. The hinged cover at the top of the box is then raised so that the film may be viewed as it is projected upon the white surface of the film pack adapter slide.

When a scene from which an enlargement is desired appears upon the screen, the projector clutch is disengaged, the enlarger shutter closed, the pack adapter slide removed and the picture is projected just as one would project a single frame upon a screen. Then the enlarger shutter is pressed, giving an instantaneous exposure and producing a properly timed negative from any correctly exposed frame of reversal or positive film.

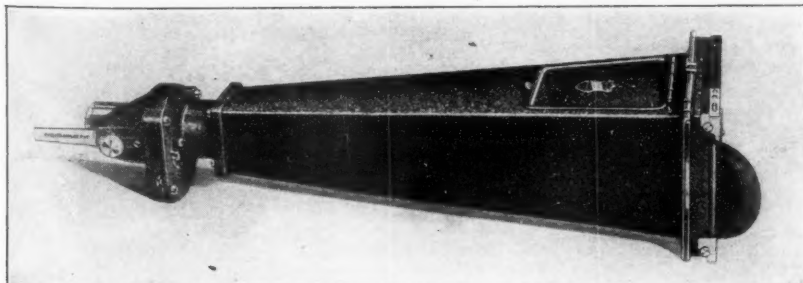
Phonograph Speedometer

PHONOGRAPH records are cut at a certain speed of the revolving wax disk. Reproduction at the true pitch can therefore be expected only if the record is turned under the pick-up at exactly that same speed. Victor records, for example, are cut at 78 revolutions per minute, Brunswick and Edison at 80 revolutions per minute, and some foreign records at 90 revolutions per minute. An electric motor or a spring is the driving power for reproduction, both of which are equipped with a mechanical speed regulating device,

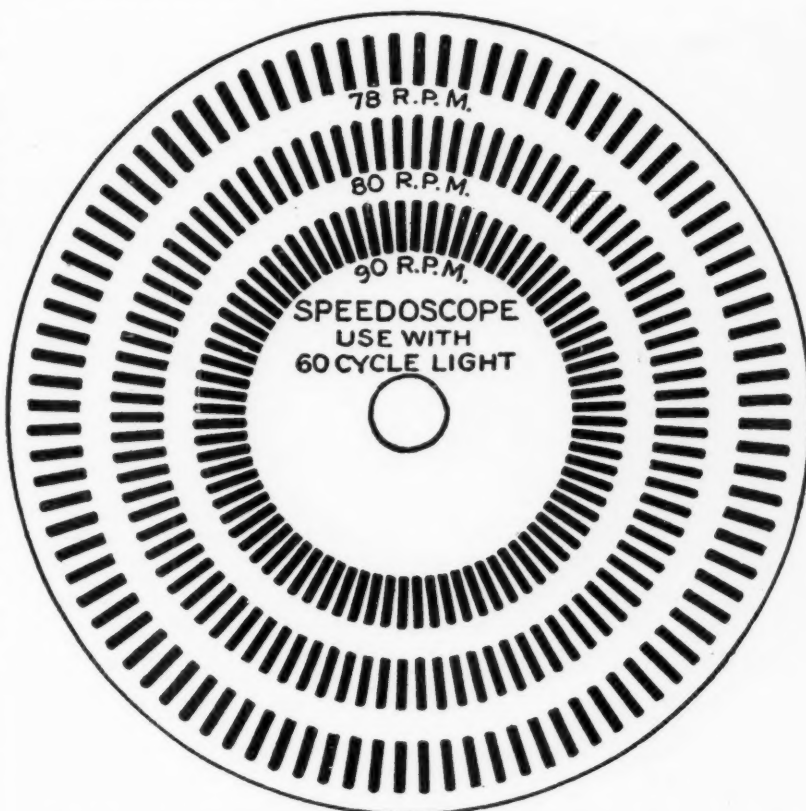


Enlargements from amateur "movies" may easily be made with the attachment shown

based on the brake principle. Gradual wear of this brake prevents a once properly adjusted speed being maintained for an indefinite period. The manufacturers recommend, therefore, that the speed of the turntable be checked occasionally by fastening a strip of paper to the record, and counting revolutions with the aid of a watch—a very uncertain method at best.



The device for making enlargements of amateur "movies." It consists of a tapered box through which the film is projected until the proper picture is visible. A film pack is then fitted and the picture is projected thereon



Cut this out or trace a copy of it for determining the speed of your phonograph. Speedoscopes for other speeds than those shown may be calculated

The following electrical method is recommended to all owners of a phonograph:

Cut out the accompanying circular disk including the hole in the center. Place this paper disk on a record while it plays, in a room illuminated with an ordinary tungsten filament lamp, operated from a 60 cycle alternating current supply. If a Victor is to be played and its speed is correct (78 revolutions per minute), the outer row of lines will appear a *stationary* circle of gray bars. If the record runs too fast, the bars will appear to move slowly in clockwise direction; if too slow, counter-clockwise. The action will be less pronounced if very high wattage lamps are used in the room, but even with the light of a 150-watt lamp it will be sufficiently plain to see at a glance, whether the speed is correct. Lamps of 25 to 40 watts are best. For Brunswick and Edison records the middle circle should be watched, while the inner row is for records requiring a speed of 90

revolutions per minute. After checking the speed it is a simple matter to adjust the phonograph to run at the desired speed by turning the speed regulator with which each phonograph is equipped.

The principle of this convenient speedometer is, of course, the stroboscopic action between a correctly chosen number of equally spaced black and white bars and the otherwise unnoticeable light fluctuations of electric lights operated by alternating current. For 60 cycle light the foreign circle contains therefore 80 black bars, corresponding to 90 revolutions per minute, the Victor circle has 92 black bars, while 90 bars are contained in the Edison and Brunswick circle.

A rather startling effect is obtained if this revolving disk is illuminated with either a spark gap, an arc light or a neon lamp. Having no thermal inertia, these illuminants actually give zero light while the current passes from plus to minus, which makes the disk apparently stand still with bold black and white bars, while Mazda lamp light shows a distinct accumulation of stationary gray bars, a mixture of black and white.

It is believed that the stroboscopic effect was first demonstrated by Mr. J. B. Taylor, and the simple disk, shown in this article, was later perfected by Mr. T. A. E. Belt.

For direct current operated light the device is obviously useless. On the other hand, it is readily possible to design a similar disk for any other frequency, or any other desired speed according to the formula

$$\text{Number of Black Bars} = \frac{\text{Frequency} \times 2 \times 60}{\text{revolutions per minute}}$$

Learning to Use Our Wings

Latest Facts About Airplanes and Airships

CONDUCTED BY ALEXANDER KLEMIN

In charge, Daniel Guggenheim School of Aeronautics, New York City

A New Cooling System

ROUGHLY speaking, one third of the heat developed in an internal combustion engine has to be dissipated by cooling, if the internal walls of the cylinders are to be kept at a safe temperature. In an engine of large power, the heat to be dissipated is enormous—millions of thermal units per hour. That is why the radiator of a water-cooled engine has to be so large, and because it is large, it weighs a great deal and offers an enormous head resistance.

The rate at which a radiator can dissipate energy depends on its design, on the speed of the air rushing through it, and on the temperature difference between the hot water in the radiator and the cool air.

When water is used as the circulating medium, its temperature must not exceed 180 degrees, Fahrenheit, or there is the risk of the water boiling away.

Quite frequently other cooling media have been suggested. Some authorities have worked out the possibility of an evaporative system, with water converted into steam. Such systems are apt to be somewhat complicated. Other suggestions have been in the direction of using a chemical other than water and having a higher boiling point. With such a cooling medium a higher temperature than with water is allowable; hence there will be a higher temperature difference between liquid and the air, and consequently a smaller radiator may be used.

The Army Air Corps engines have made some apparently very successful experiments with ethylene glycol, commercially termed Prestone, the boiling point of which is so high that its outlet temperature may be 300 degrees, Fahrenheit. If the air is at 60 degrees, this gives a temperature difference of 240 degrees instead of 120 as with water. Quite a number of flights have been made with a Curtiss pursuit plane, mounting a Curtiss D-12, 400 horsepower engine. The maximum temperature of the fluid was found to be 270 degrees after ten minutes of full throttle operation. The radiator employed was only one third the usual size, and the weight of the airplane was also reduced by some 90 pounds.

Ethylene glycol is not a newly discovered compound. It is largely used as an anti-freeze mixture in automobiles and is obtainable at reasonable prices. "It is the first and simplest of the class of polyhydric alcohols. It is a clear, colorless, odorless liquid and has a slightly sweetish taste. Its chemical formula is $\text{CH}_2\text{OH} \cdot \text{CH}_2\text{OH}$."

A number of minor difficulties appeared. Joints and packing glands had to be tighter than with a water system. The expansion is greater than that of water, so the expansion space has to be larger. There is a tendency to soften the rubber lining in the hose connections. The oil temperatures ran high, a problem which can be

solved by using a different oil or an oil cooler.

These difficulties are sure to be overcome and it is possible that a great improvement is to be provided for our aircraft.

The Helicogyre

THE Autogyro of Senor de la Cierva has achieved great success from the point of view of low landing speed and short run after landing. Whether its efficiency at high speed can be made as great as that of the airplane is a question. Its main difficulty at the moment is that it takes a long run and a long time to take off. If to the present good qualities of the Autogyro could be added a short get-away run and a quick take-off it would be an absolutely ideal machine for flying from or to restricted territory. Now an Italian inventor, Signor V. Isacco claims to have gone a step farther with his Helicogyre, in which the automatic rotation of the windmill or rotating blades is replaced by blades which are driven by engines and propellers placed at the tip of each blade.

Although Signor Isacco has presented a paper before the Royal Aeronautical Society, complete information is not as yet available. The new type of aircraft is illustrated in the diagram.

It embodies a conventional fuselage, landing gear, and tail surfaces. At the nose of the fuselage is mounted an Armstrong-Siddeley Genet engine of 75 horsepower, driving a conventional two-bladed propeller, so that forward movement is obtained just as in the airplane. Instead of the usual wings, however, two large blades are used, one on either side of the fuselage. The blades are free to rotate about a vertical axis. At the point of

connection to the vertical axis, these blades are so articulated that they can move up and down in the direction of the lift, and are also so articulated that they can move slightly back and forward.

At the ends of the blades are mounted two Bristol Cherub engines of 32 horsepower, each driving its own propeller. It is the thrust of these auxiliary propellers which pulls the large blades around. The rotating blades are provided with ailerons and for hovering control two small surfaces are fixed to the fuselage. The gasoline tanks for each of the small engines are mounted inside the wings. The machine illustrated in the diagram, which is the second one to be built, weighs 1320 pounds and rose into the air several times using only 50 horsepower. The machine is only in the preliminary test stages.

A number of questions immediately suggest themselves.

Can the Helicogyre rise vertically into the air? There seems to be no reason why it should not. By using wing-tip engines, the gearing and transmission weights of the helicopter are avoided and the gross weight can apparently be kept at a reasonable figure. The weight per horsepower of the wing engines is not much over 20 pounds, and a lifting aircrew can readily operate at this load.

Can the machine achieve forward motion? There is no reason why it should not. The forward propeller has sufficient power behind it for propulsion, and the propulsive effort can evidently be increased by tilting the central axis forward, in which case a component of the lift of the blades will act forward.

Will the craft be stable laterally? With a single rotating surface, the blade going into the wind (when there is forward mo-



Left: A Curtiss Falcon with a D-12 engine, water cooled. By using Prestone for cooling, the radiator on the ship at the right has been reduced in size

tion) is evidently receiving a speedier relative wind than the blade moving away from the wind. But just as in the Autogyro, the blade moving into the wind should move up, and thereby have its angle of incidence diminished, while the blade moving away from the wind should move down and thereby change its angle of incidence. Therefore there is good hope of lateral balance.

Should the machine be able to land slowly? It certainly should with the auxiliary engines functioning. Even if the forward propeller and the side engines quit, there is no reason why the blades should not continue to rotate in windmill fashion and give a landing as good as the Autogyro.

The answers to these questions might (if they appear reasonable) lead the reader to believe that the Helicogyre is the ideal aircraft. Unfortunately it also appears to offer many difficulties.

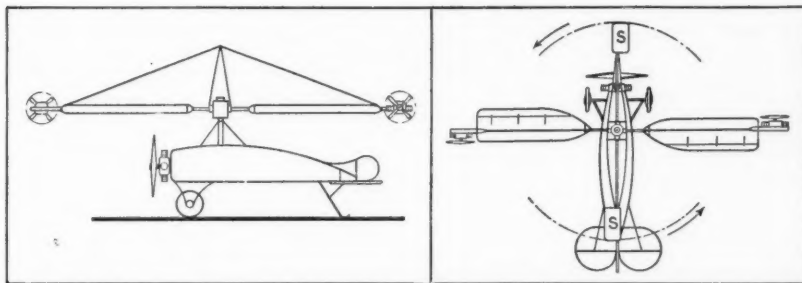
Control in hovering or vertical ascent is extremely difficult and it does not appear that the small surfaces marked S in the diagram will be at all sufficient to secure control. In vertical ascent the craft may be largely at the mercy of contrary gusts.

The lifting windmill of the Autogyro has a far lesser lift-over-drag or efficiency ratio than a good airplane wing. It does not seem likely that the rotating system of the Helicogyre will be any better. The propellers of the auxiliary engines will be working under varying aerodynamic conditions, and while the propeller on one side will be pulling back, the propeller on the other side will be pulling forward. The over-all efficiency is likely to be very low.

The difficulties experienced with the old rotary engines have led to the entire disappearance of this type. The difficulties due to centrifugal force and possible unbalance with the engines rotating at the end of a long arm are likely to be still greater. Since the auxiliary airscrews are going to work at rapidly varying conditions, vibrations in the auxiliary engines are quite possible.

When considering radically new types of aircraft, we must also remember that the airplane with the assistance of slots and flaps is gradually approaching the ideal condition of short landing runs and short get-aways.

Dr. Whimperis of the British Air Ministry has said, however, when discussing Isacco's device "But the greatness of the



Redrawn from Flight

Side and front views of the Helicogyre, the latest effort toward vertical ascent and descent in heavier-than-air craft. Engines at the tips of the horizontal blades cause them to rotate, and another engine drives the plane forward

difficulties in the path adds to the zest of the adventure. The potentialities of the rotating wing must be explored and they will be explored. We cannot go forward with the conventional type of airplane with complete confidence that we are on the right path, if we leave behind us uninvestigated the potential qualities of the rotating wing."

A Flush Instrument Board

IN many accidents of comparatively minor character, pilots have been seriously injured by being pitched forward on the instrument board, and particularly on projecting parts of the compass. The remedy lies in providing padding above and around the instrument board, the padding to project forward. Another helpful factor is to design the instrument board so that it presents a flush or smooth surface. A small Pioneer instrument panel is shown in our photograph, where all the instruments including the magnetic compass are flush with the board.

The Lehigh Airport Competition

COLONEL CHARLES LINDBERGH has recently stated that American airports are not up to European standards. We believe that this condition is due to the fact that only recently have American operators undertaken to carry passengers, and that the special facilities and precautions necessary when passengers are carried will be provided almost as a matter of course. The Department of Commerce has been doing very useful work in the im-

provement of airports by providing ratings and laying down general rules for their design. The Lehigh Airports Competition, sponsored by the Lehigh Portland Cement Company, is certain to elicit some novel designs and suggestions. The prizes offered are a first prize of 5000 dollars, a second prize of 2500 dollars, a third prize of 1000 dollars, a fourth prize of 500 dollars; and ten honorable mentions carrying awards of 100 dollars each.

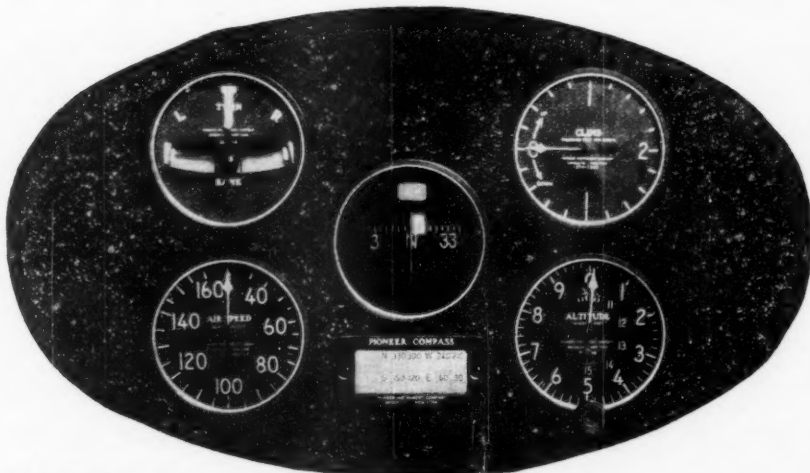
Each competitor is to assume a sea-level airport of sufficient size to provide an effective landing area of 3500 linear feet in all directions. The circular announcing the competition states that at present planes are not designed for operation on grades greater than 2½ per cent. This statement may be criticized, but certainly operations are facilitated by an approximately level site. The average airplane of to-day may be assumed to have a gliding angle of 1 in 7. The competitors are to assume accordingly that structures of 50 feet in height may be found at the outskirts of the field, and that a marginal strip all around the flying area of 350 feet in width will be required.

The entire field is to be enclosed with a fence which will prevent the access of unauthorized persons to the flying area. As air traffic increases, more and more precautions of this character will have to be observed. At present anyone can stroll into and upon the flying area at will, with hazard to himself and inconvenience, to say the least, to pilots.

Because of the practical limitations in cost of developing a suitable all-over surface for a large flying field, it is now customary to provide paved runways, each not less than 100 feet in width, for landing and take-off. The competitors are to indicate on the plan of the field an arrangement for such runways, giving safe landing under all ordinary conditions of wind and weather. Adequate lighting facilities are of course to be provided.

Only a year or so ago an airport was considered well nigh perfect if proper landing and lighting facilities were provided. The authors of the competition now call for innumerable "accessories."

In the marginal strips, space must be provided for parking automobiles and for mooring planes. Easy transportation facilities, other than by air, are now considered essential. Passenger concourse and waiting room of 2500 square feet are to be indicated on the plans, with ticket wickets, office space for traffic manager and officials of at least four air transport companies, and all the normal accessories of a railway passenger station. "An important essential is to provide safe access for passengers, protected from the weather, to the loading



Courtesy Pioneer Instrument Company

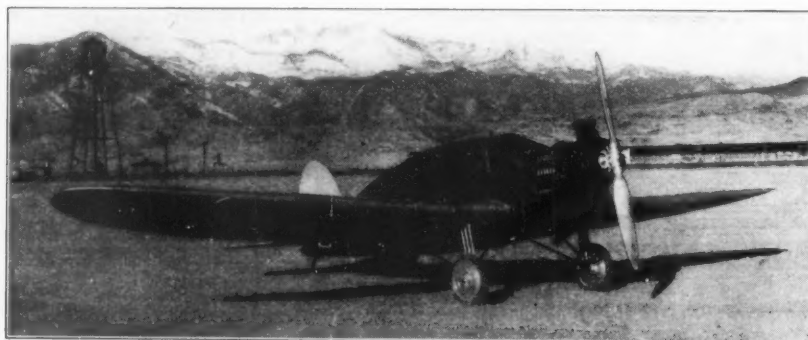
Possibility of injury from instruments in a crash is reduced by this new instrument board, in which the units are placed flush with the front oval panel

point for transport airplanes." There must be suitable hangar facilities for plane repair and space for fire apparatus, ambulance, and so on. A hotel and concessions are to be incorporated in the plans.

It is extraordinary to think that such a competition is in being to-day. Three short years ago it would have been regarded as visionary.

Eaglerock Bullet

AIRPLANE designers are always striving to reach the ideal aircraft which shall be nothing but a flying wing. One of the steps in such evolution is the use of a retractable landing gear. Retractable landing gears have been frequently used in racers and in amphibians. There is reason



Three quarter view of the neat looking Eaglerock Bullet

to believe that they will also be employed in ordinary commercial landplanes.

Indeed, the Alexander Aircraft Corporation has already brought out a four passenger cabin monoplane, the Eaglerock Bullet, in which a retractable landing gear is successfully employed. The method of retracting the landing gear is said to be quite fool proof. Whether up or down its condition is always apparent to the pilot. A hand wheel on the front wing beam is used to draw up the gear into specially designed compartments, and when the gear is retracted the underside of the fuselage is completely streamlined. Equipped with a Kinner 100 horsepower engine and carrying four passengers, the Bullet has attained a high speed of 130 miles per hour. Our photographs show the clean appearance of the "Bullet" with its gracefully tapered, cantilever monoplane wing.

Airplanes Make Pastures of Cutover Timber Lands

AIRPLANES are making the desert blossom, if not exactly as the rose, at least as first-class pasture land, in large areas of cutover timber land in the Pacific Northwest. They have added to their already long list of accomplishments the rôle of broadcast sowers of grass seed, and the first experiments have shown them to be much more successful and rapid than hand workers, as well as more economical.

Timber companies in the Northwest have found the problem of the large areas of stripped lands left on their hands after logging operations a serious one. The most economical use appears to be to burn the "slash" and then sow the area in grass and use it as sheep or cattle pasture. But the land is for the most part very broken and rough, and men on foot have a hard time seeding it. This method proved to be so

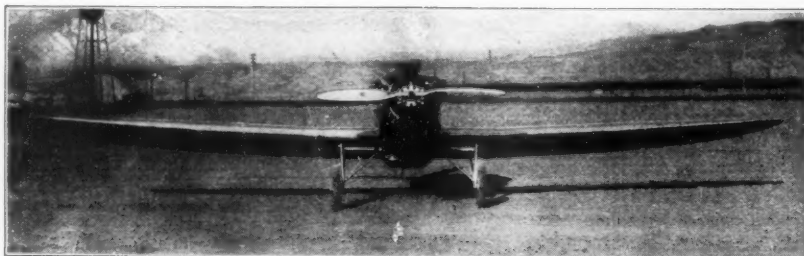
slow and expensive that it has been employed only where conditions were ideal.

One corporation hired a plane and pilot from a commercial flying company. A special hopper was built for releasing the grass seed, which was spread out in a wide stream by the propeller blast. Flying fairly low across the newly burned-over land, the plane sowed the grass seed into the loose ashes, which served as a receptive and well-fertilized seed bed.

One plane was able to sow from 150 to 200 acres of rough land a day. The best that a man on foot can do over similar terrain is five to eight acres a day. Even counting the high cost of plane hire or ownership, the flying method of sowing is by far the cheaper, averaging 40 to 60 cents an acre, as against a cost for hand sowing of

75 cents to \$1.25 per acre. Moreover, plane sowing requires only six or eight pounds of seed per acre, while the hand method uses ten or twelve. Since grass seed costs from 30 to 35 cents a pound wholesale, this item is not inconsiderable.

The work of sowing over broken ground is not without its dangers. The planes have to fly fairly close to the ground, and the broken surface and frequent deep side ravines cause all sorts of treacherous air



Front view of the Bullet. The chassis can be retracted into the fuselage

currents. The aviator has to be constantly on the alert, for a forced landing would almost certainly mean a crash. However, all the work to date has been accomplished without accident.—*Science Service.*

Our First Army Pilot

IN THE article "Builders of the Aviation Industry" appearing in our March issue, it was stated that Brigadier-General Benjamin D. Foulois is "the first army air pilot in point of service." When exception was taken to this by a reader, we wrote the Army Air Corps and the following is a part of the reply we received:

"... the Chief of the Air Corps has directed me to inform you that General F. P. Lahm was the first army

officer to pilot an airplane, General B. D. Foulois was the second Officer to receive his flying training. Neither of these officers have, however, been continually with aviation since they finished training so that from the point of view of continuous aviation service it is believed that Major T. D. Milling has served longer than any other officer."

How Long Will An Engine Last?

A. H. R. FEDDEN, a British Designer, lecturing before the Royal Aeronautical Society, recently gave some remarkably interesting statistics on the life of aircraft engines.

On the Imperial Airways lines in the Middle East, where Bristol Jupiter engines of approximately 450 horsepower are employed, the following figures apply:

Average hours operation per engine	469 hours
Maximum recorded hours, one engine	960 hours
Average hours between overhaul	400 hours
Average man-hours for overhaul	1356 hours

On the K. L. M., or Royal Dutch Air Lines, operating between London and Holland, using the Jaguar engines:

Average hours between overhauls	400 hours
Average man-hours for overhaul	480 hours

For the Wright Whirlwind of 200 horsepower, Mr. Fedden secured data from nine different operators:

Average hours operation per engine	401 hours
Average hours between overhauls	290 hours
Maximum recorded hours on one engine	2000 hours

These figures show a vast improvement over those of three or four years ago.

For Cirrus engines used by English light-plane clubs, the data secured are as follows:

Average hours operation per engine	290 hours
Maximum recorded hours on one engine	403 hours
Average hours between complete overhaul	360 hours
Man-hours for top overhaul	25 hours
Man-hours for complete overhaul	100 hours

The figures for the Cirrus are of particular interest to our own flying clubs who will use engines of similar power, and who from reliable experience such as this should be able to compute the running and depreciation costs of their engines with accuracy.

In the same paper, Mr. Fedden also discusses the relative merits of the radial air-cooled engine and the in-line air-cooled

engine. The diagrams illustrate installations with a 12 cylinder in-line engine and with a nine cylinder air-cooled job.

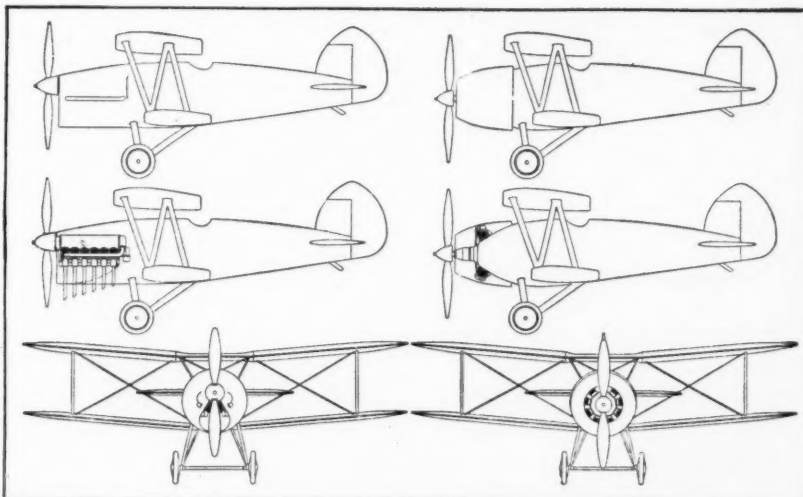
The exponents of the in-line engine stress its smaller head resistance. But by completely enclosing the radial engine with suitable cowling, allowing an opening at the center as shown in the diagram, the head resistances can be put on a footing of equality with the in-line type. In the large airplane where the body is necessarily of big dimensions, the radial may actually score in head resistance, because there must be a big air-resistance-producing body, regardless of the engine used. Further, with the radial engine, cooling will be less of a problem because all the cylinders are equally exposed to the air blast. There is no rear part of the engine to receive air which has already been warmed by the first cylinders. Again, the radial engine has the advantage of light weight and compactness. In spite of the growing popularity of the in-line engine, evidently the controversy over the two types is far from being closed.

The Boeing 80-A

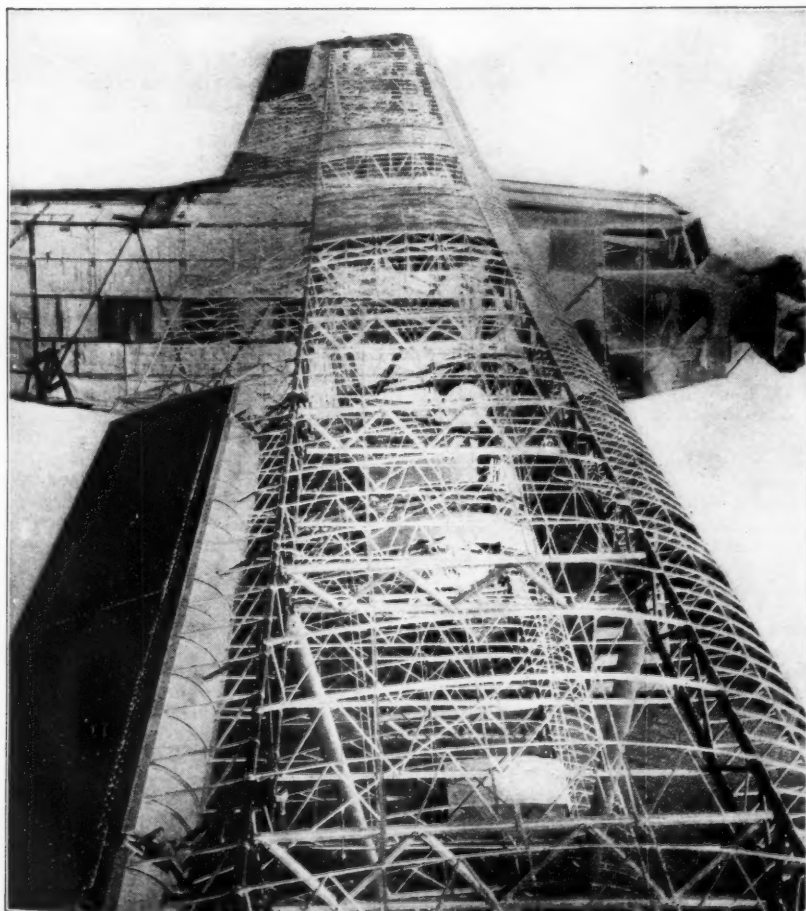
COLONEL LINDBERGH thinks that larger and larger planes will be needed for passenger air transport, and that four-engined planes are likely to come soon. In the meantime quite a number of large three-engined planes are already in use or in process of construction. One of the most interesting of these is the Boeing 80-A, a twenty-place cabin monoplane of the following characteristics. Length overall,

55 feet; height overall, 15 feet 2 inches; upper wing span span, 80 feet; lower wing span 64 feet 10 inches; wing area 1220 square feet. The useful load is 7133 pounds and the gross weight fully loaded is 16,500 pounds. Powered with three 525 horsepower Hornets, the high speed is 135 miles per hour, and the initial climb 900 feet per minute.

Our photograph is unique in showing



The illustrations in the vertical row at the left are of a 12-cylinder "V" type water-cooled engine. At the right are similar views of a 9-cylinder totally inclosed air-cooled engine. See article on the opposite page and at the left



A most unusual view of a three-engined ship without the wing fabric in place. Only the ailerons are covered. Notice the maze of cross braces and struts

the airplane apparently complete but without covering on wings or fuselage. It will repay careful study. What is at first glance a meaningless maze is on the contrary a beautiful and instructive view of the structure of a modern airplane. Looking at the upper wing we see that the spars are built up of two steel tubes with welded diagonal tubes in between the two tubes forming the upper and lower flange of the girder. The ribs are also in the form of an engineering truss, apparently with square dural channels. The interplane struts are of streamline steel tubing. Swaged tie-rods are used in the internal truss of the wing. The huge ailerons are apparently covered with sheet dural and are supported on brackets from the rear spar.

Airport Sign and Signal

A COMBINATION sign to attract visitors to the airport, and to serve as a signal for pilots in the air has been constructed at the Visalia, California, airport



Advertising the airport

by A. A. Clark, director of the aeronautics division of the Visalia Chamber of Commerce. This signal consists of a canvas curtain that may be marked with any device that is desired. When a rope is pulled, the curtain rolls up on a roller under a metal hood which also serves as a housing for the reflector and electric light bulbs. Signals may be seen by night or by day and several rolls may be accommodated.

The Month in Medical Science

Progress in the Medical and Surgical Fields

By MORRIS FISHBEIN, M. D.

Editor of the Journal of the American Medical Association and of Hygieia

Sudden Death of Motorists

NOT infrequently newspapers report cases of sudden death in drivers of motor cars. In most of these instances, the persons in apparently good health have started out on a drive and have been found dead in their car by the roadside. In other instances, cars have toppled into ditches and into rivers due to the sudden death of the drivers. Physicians in Chicago have recently published three instances of this character. A man aged 65 was driving an automobile which was suddenly noticed to be going from side to side and finally to go off the embankment and turn over. A post-mortem examination revealed changes in the heart which indicated that death had occurred from heart disease before the car went off the road. Although blood was found under the scalp, there was no fracture of the skull and no hemorrhage or other abnormal change in the brain.

In the second case, a man aged 67 was driving a motor car over a dry concrete road. People in the following machine noticed that the car suddenly began to zigzag; finally it left the road and turned over in a shallow ditch. First inspection indicated that death had resulted from a skull fracture and injuries to the brain, but when a post-mortem examination was made, the skull fracture was not found, the brain was uninjured, and sufficient changes were found in the blood vessels and heart to indicate that death had occurred suddenly from stopping of the heart.

It is pointed out that people who die from such changes in the heart sometimes die sitting upright in a chair, on the seat of some public conveyance, and frequently so quietly that other people sitting nearby are unaware that death has occurred.

Numerous instances of this kind that are available in medical records are still further indication of the necessity for some sort of physical examination for people who drive motor cars, particularly in congested traffic of great cities.

How Gilbert, American Composer, Conquered Heart Disease

ONE does not usually search in medical periodicals for extraordinary biographies or for the records of noted musicians. Nevertheless, the true story of the life of Henry F. Gilbert has been told in such a periodical by his physicians, Drs. Paul D. White and Howard B. Sprague, and it constitutes one of the most inspiring documents that has thus far been made available relative to those who have conquered their handicaps and lived lives of usefulness to humanity.

Henry F. Gilbert, the American composer, was born of old New England stock in Somerville, Massachusetts, on September 26, 1868. His father was a composer and organist and his mother was a singer. At birth he suffered with

certain defects of the heart which were to control him during his entire life. These defects involved narrowing of some of the valves of the heart, a defect in the tissue that divides the heart chambers, an enlargement of the right ventricle of the heart which is especially concerned with forcing blood throughout the body, and an unusual position of the large blood vessel leading away from the heart. This combination of conditions has been named the "tetralogy of Fallot" after the famous French physician who first described it in 1888. Associated with the condition there is enough interference with the circulation of the blood to cause clubbing of the fingers so that they are very broad at the tips and



Portrait of Henry F. Gilbert. Cyanosis of the cheeks and hands, and clubbing of fingers can be seen

also a general blueness which is particularly marked over the cheek bones.

Because of the interference with his circulation Gilbert was unable to play vigorously during childhood. He became easily fatigued and short of breath. Many times physicians expressed doubt that he would survive to adult life. Dizzy spells and headaches attacked him not infrequently. As he grew older he sometimes staggered like a drunken man and fainted on one occasion during a rehearsal of one of his pieces of music. As a young man Gilbert studied with Edward MacDowell, the famous musician. In 1901 when Gilbert was 33 years old he went to Europe on a cattle boat to hear the opera "Louise." He determined to devote the rest of his life to the development of American music. His "Negro Rhapsody," "Indian Sketches," and "Dance on Place Congo" are an indication of some of the themes that won for him international recognition. During his later years his heart action and respiration

were improved by the use of digitalis, the drug that has been recognized as one of the great sheet anchors in the treatment of disease of the heart.

On May 19, 1928, Mr. Gilbert died in Cambridge, Massachusetts, of apoplexy. He was 60 years old and he had made of his crippled life, in the words of Dr. White, a great success. A post-mortem examination revealed the soundness of the diagnosis and the manner in which the tissues, abnormal at birth, had accommodated themselves to carrying on the life of this remarkable figure. His story should bring hope and inspiration to every other victim of heart disease.

Botulism and Home Canning

RECENTLY a meal of home-canned string beans was served to a group of Italians in Westfield, New York. Thereafter eight of the people who ate the beans became severely ill and four died, apparently from botulism transmitted through the beans.

For more than five years the *Journal of the American Medical Association*, the United States Public Health Service, and the canners' organizations have issued warnings relative to the danger of botulism from home-canned string beans canned by the cold-pack method. The departments of home economics in colleges and universities have endeavored to educate people regarding the danger.

Many of the recipes for the home-canning of vegetables antedate our present knowledge of botulism. The organism and its poison are difficult to control, and the public must realize that every non-acid vegetable should be rendered safe either by sterilization for a sufficient time and temperature in a pressure cooker, or by drying, or by the addition of 10 percent of brine solution. The only other alternative is long boiling, after removal from the glass jar, which serves to destroy much of the value of the vegetable itself. The commercial canners have learned the lesson and render their products safe by suitable steam heating under pressure during the canning process.

Mosquitoes and Horses

THE Bureau of Malarial Control of Porto Rico recently conducted a series of investigations which proved that when horses and men slept in the same house mosquitoes attacked the horses and only rarely the men. When the animals were removed from the vicinity of the house, the mosquitoes at once returned to the human diet.

A European investigator published in the *Annals of the Pasteur Institute* related investigations which indicate that the mosquito is highly adaptable to conditions that affect its opportunity to live on animal blood. Those mosquitoes which live on

live stock develop stronger mouth parts than those that feed on man. If live stock is kept outdoors in a windy country, the mosquito will seek the interiors of the house and feed on the human beings in the house. However, if the animals are housed in good stables, the mosquitoes are more likely to seek them.

The control of all of the parasites that afflict mankind depends just as much on an intimate study of their natural history and the way in which they live as on any other factor.

Digestion of Meat

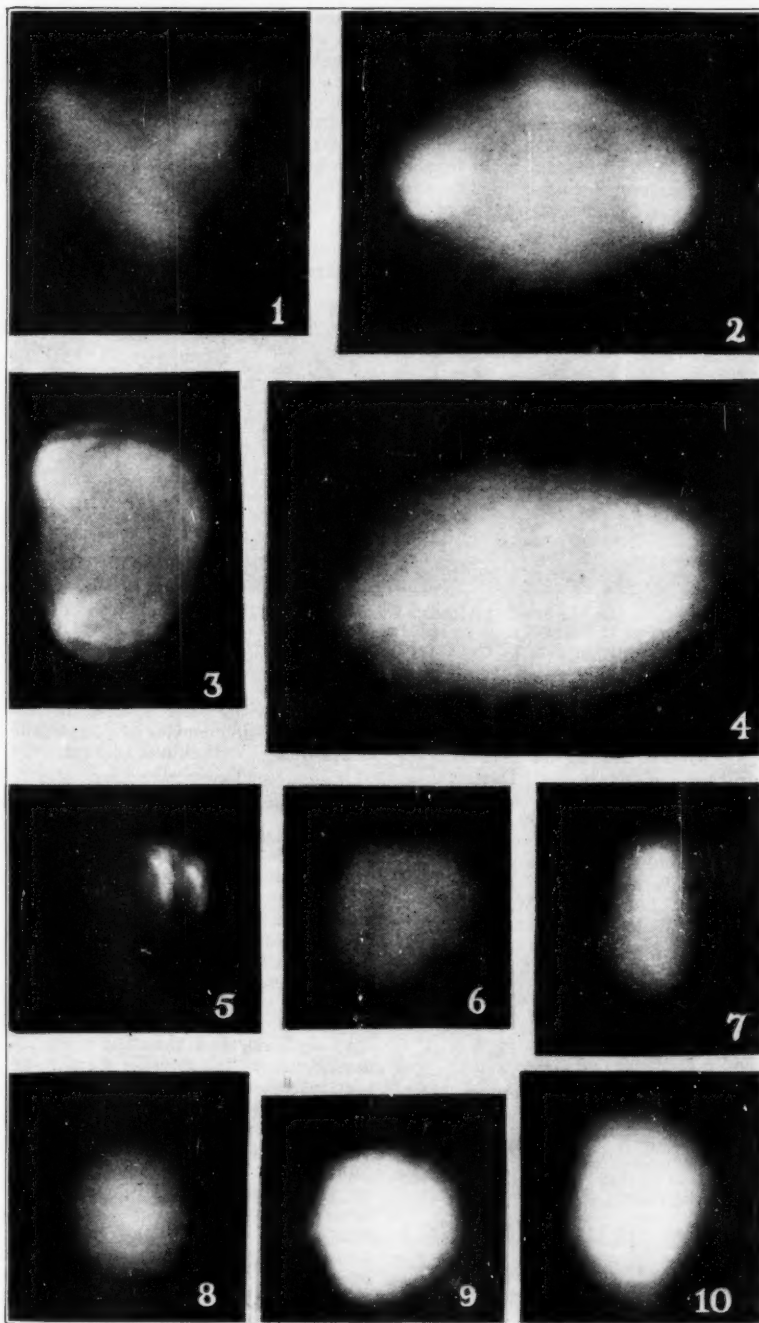
FOR some time the physiologists have emphasized the idea that meat is a sort of stimulant to the digestion in so far as it gives the stomach something to work on, in addition to providing nutriment of importance for the human body. Recently Drs. Martin E. Rehfuess and George H. March of Philadelphia have made a careful study of the gastric digestion of meat in health and in disease. They found that meat induced the highest degree of acidity in the human stomach and that the secretions of the stomach varied with meat from their reaction toward breadstuffs and cereals.

As a result of testing the digestion of meat in patients with a large variety of diseases, it has seemed to the investigators altogether probable that serious systemic diseases involving impaired function of the stomach likewise impair the ability of the stomach to digest meat. The evidence indicates that observations on the body in health cannot by analogy be carried over to the body in disease. In health, meat acts as a stimulant to the gastric function. In disease it does not act to produce a maximum response on the part of the secreting membranes of the stomach and hence must be used with considerable caution. Another advantage of the investigations has been to provide a sort of diagnostic test which will enable the physician to differentiate in the diagnosis of diseases of various types affecting the stomach.

Radioactivity After Death

WHEN radioactive substances enter the human body, there is a continuous bombardment of the tissues by the radiation, with effects on the bones and on the blood. These changes have been noted by various observers and today one exercises great caution in the use of these substances. As an indication of the permanency of effects, the observations made by Drs. A. V. St. George, Alexander O. Gettler, and Ralph H. Muller are striking.

Some years ago a number of employees in a factory in New England were engaged in painting watch dials with a mixture containing a small amount of radium and mesothorium to make the watch dials luminous. One of these employees was an unmarried Italian girl about 23 years of age. In her work she was accustomed to pointing the brush between her teeth. She developed vague aches and pains which were distinctly diagnosed as rheumatism. Her symptoms became worse and in 1922 she was found to be suffering also from syphilis. She died on September 12, 1922, and these diseases, including some inflammation of the mouth and bleeding of the gums, were assigned as the cause.



Radium rays from various tissues of the body five years after death, in a case of industrial contact with radium. 1; piece of lower jaw; 2; vertebra; 3; femur; 4; femur through lead; 5; tibia; 6; liver; 7; metacarpal bone; 8; brain; 9; lung; 10; spleen ash. For details, see also item in the column at the left

Since that time, it has been found that other employees working in industries of this character have died or become severely ill from the effects of radium. Because of the question of compensation, the body of the girl mentioned was disinterred five years after burial, a post-mortem examination made and the tissues studied for the presence of radioactive materials. Every portion of bone and of tissue tested, including the bones of the jaw, the spine, the legs, the hands, and the liver, brain, lungs and spleen, indicated the presence of radioactive material. Tests made with an electroscope and with photographic plates confirmed these observations.

Apparently radium salts taken into the body find permanent lodgment in the tissues and have a predilection for the bones. The bombardment of the bones by radium rays causes increased brittleness and eventually the death of the tissue.

Mental Excitement and Brain Stimulation

THERE are certain drugs which have the power of bringing about stimulation of the brain through cutting down the oxygen and increasing the carbon dioxide in the body. It occurred to investigators in the University of Wisconsin, working

under a grant from the Ella Sachs Plotz Foundation, that it might be of value to stimulate the brains of patients with various mental disorders.

Patients with dementia praecox, melancholia, and manic depressive insanity were treated by the use of drugs that might bring about such effects and with inhalations of a mixture of carbon dioxide and oxygen. It was found that persons in the stuporous phases of certain psychoses received definite stimulation of the brain by this method, and indeed by these

ripened and ethylene ripened tomatoes were richer in vitamin C than was the green fruit. Vine ripened tomatoes, however, contained more vitamin C than either green or artificially ripened tomatoes.

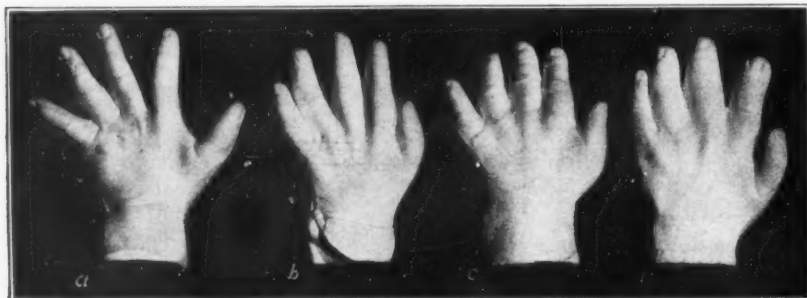
Moreover, a research in the Michigan State College brought out the fact that vitamin A is present in green asparagus, whether freshly cooked or canned, but that bleached asparagus does not contain enough of this substance to prevent death in white rats that are undergoing vitamin A starvation. This observation is easily

and long and narrow, and the intestines short and active. The linear type of person has a thin skin and tends to be underweight.

The lateral type has a broad head, a wide and low nasal bridge, prominent strong lower jaw, short neck, rounded shoulders, large bones and, in fact, tends to be the opposite of the linear type. In the lateral type of person the stomach and intestines are long and sluggish, and he tends to be overweight.

Many psychologists have attempted to associate personality with body build, assigning to the linear type such qualities as idealism, egoism, fastidiousness, moodiness and cynicism; to the lateral type, talkativeness, good humor, and plodding perseverance.

The Drs. Bakwin were able to classify infants by this method in their nutrition. They found, moreover, that babies suffering with malnutrition tend to be of the linear type, whereas those with eczema were of the lateral type. Obviously, therefore, the type of body build of the infant must be taken into consideration in determining whether or not it is maintaining a proper weight. Because of the body build, one tends to gravitate into certain types of occupation. All of these factors are taken into consideration by the modern scientific investigator.



Variations in the shape of the hands in infants. *a*; long, narrow hand of the linear type of infant; *b* and *c*; intermediate types of hands; *d*: short hand with the stubby fingers of the lateral type of infant. These different types and their characteristics are discussed at length in the center column below

simple chemical procedures, the mental process in certain psychotic patients were restored toward normal for periods from two to twenty-five minutes. During these times, therefore, it was possible to ask questions and receive answers and to make other studies of the greatest importance toward yielding eventually an understanding of the nature of these diseases.

Drs. A. S. Loevenhart, W. F. Lorenz, and R. M. Waters, who carried out the work, found that during the periods of brain stimulation the patient would suddenly develop an intelligent appearance, hold a clear conversation and even exhibit a remarkable memory for past occurrences. Certain persons who usually had a smirk or silly grin would develop an interested expression and those who were apathetic became quite animated.

The preliminary report of the Wisconsin investigators indicates new possibilities for a solution of these important problems.

Ethylene and Vitamin Content

FOR several years it has been known that fruits and vegetables may be ripened rapidly by the application of ethylene gas. In 1927 attention was called to the possibility that such artificial ripening, while it served to hasten the coloring of the fruit and vegetables, might interfere seriously with their vitamin content. In 1928, investigators showed that celery bleached by ethylene does not differ in vitamin B content from ordinary celery, but recent investigations by chemists in the Iowa Agricultural Experiment Station bring out new facts regarding the vitamin content of tomatoes.

No difference was found in the vitamin B content of tomatoes—green, air ripened, ethylene ripened, and vine ripened. The vitamin A content of ripened tomatoes was found to be greater than that of the green mature fruit, and the same quantity of vitamin A was developed in the tomatoes regardless of the method of ripening employed. Green tomatoes were found to be relatively poor in vitamin C content. Air

correlated with other studies indicating that the coloring matter of plants is associated with the vitamin A content.

Body Builds of Infants

ACCORDING to the Drs. Bakwin of the department of diseases of children in Columbia University, children are of two types—long and wide. More and more physicians are beginning to consider the relationship of the constitution and body build to the development and nature of the human being. It has long been recognized that boys die in much larger proportion during the first year of life than do girls, and that the male is apparently more influenced by environment than is the female.

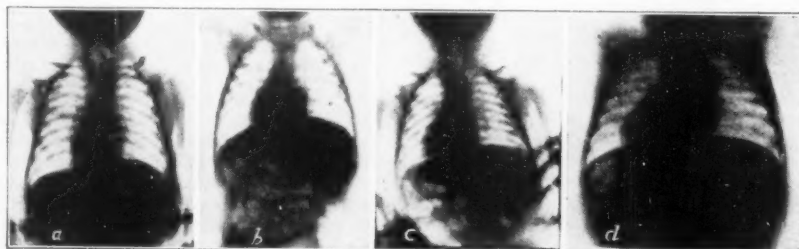
Grown-ups have been classified in all sorts of ways. The geneticist, C. R. Stockard, has introduced the classification of linear and lateral types. The linear type has a long head, a high narrow nasal bridge, sharp prominent nose, narrow mouth arch with teeth that are usually ill set, small poorly-developed lower jaw, long thin neck, long slender extremities, and slender bones and muscles. In such people the stomach is vertically placed

Damages for Cockroaches

THE British courts have awarded 481 pounds damages to a woman on the ground that the encouragement of cockroaches by neighbors on a lower floor and the consequent invasion of her premises by numbers of these insects had produced in her insomnia and nervousness, damaged her rooms and her curtains, and caused her considerable work in an attempt at extermination. Her claim included 110 pounds special damages for repairs, materials, cleaning, and medical attendance.

Her medical attendant asserted that she had been bitten by the cockroaches, and that as a result she had a severe dermatitis. However, an expert witness for the defense asserted that the cockroaches would not bite. The cockroaches were a species known as *Blatta orientalis*, which do not bite or pierce the human skin, but which eat bedbugs. Both the cockroach and the bedbug appeared in England in 1583. Both are practically omnivorous, and not only eat organic refuse of all types but also each other.

(Please turn to page 85)



Variations in shape of chest and heart in infants, as applies to the discussion entitled "Body Builds of Infants," appearing in the center column above. The plate on the left, *a*, shows a long narrow chest scarcely wider below than above, the diaphragm sloping sharply downward toward the periphery. The heart is elongated and thin and almost vertically placed. The chest shown in the plate at the extreme right, *d*, is a marked contrast to *a*. The chest is short and broad and flares markedly below. The ribs, as well as the diaphragm, are almost transverse. The long axis of the heart is almost horizontal. Chests shown at *b* and *c* are of other intermediate types

Chemistry in Industry

Advances Made in Industrial and Experimental Chemistry

Case Hardening Steel by Nitrogen Treatment

THE fact that nitrogen embrittles iron and steel is not contested, and as brittleness is but a manifestation of hardness it is not surprising to find that many attempts have been made to employ nitrogen as a hardening medium for iron and steel. It may be that in cementing and case-hardening iron with cyanides, the nitrogen plays its part with the carbon, according to a writer in *Chemical Age*. Case-hardening by nitrogen has been the subject of numerous experiments, and renewed interest has been taken in the subject since it has formed the basis of several patents recently applied for by the Krupps. The patent specifications are not very explicit, but from time to time the Krupp experiments with nitrogen have been described in the German technical papers, and the broad outlines are fairly well-known. Most of the work has been carried out by A. Fry.

The process is more particularly applicable to the case-hardening of small steel parts which it is desirable to preserve carefully from all distortion. The process is carried out, therefore, at the comparatively low temperature of 580 degrees, Centigrade, and the case-hardening and nitrogen-yielding medium employed is a gas consisting chiefly of ammonia. Heating is continued for a considerable time (40 to 60 hours) but, while the case is satisfactorily hard, it is said not to be brittle, as the temperature is below that at which the noxious nitrides (Fe_2N and Fe_3N) form. The equally noxious iron nitride eutectoid (Braunite) with which, according to Fry, the objectionable brittleness is chiefly associated, is not found in the finished and case-hardened article. The case is glass-hard and greyish in appearance when the articles are withdrawn from the furnace, but it is easily polished and retains a high surface finish. The process is applicable to parts which it would be difficult or impossible to carburise in the ordinary way.

Germany's Chemical Industry Expands

THE policy of consolidation and expansion which has characterized the operations of German chemical producers during recent years was continued in 1928, a survey of the German chemical industry just issued by the Commerce Department reveals.

During the past year, according to the survey, the German Dye Trust, representing approximately one third of German chemical production, concluded agreements with British, French, Swiss, and Italian chemical firms and acquired a half interest in a large American photo-chemical plant. In addition it officially ratified the Franco-German dye pact of 1927. In February of the current year it increased its holdings in a Swiss company by 50,000,000 dollars, a move believed to be the forerunner of further foreign investments. The most likely prospects mentioned in this connection include a Swiss dye company, and

Dutch and French rayon firms. All of these interests, it is pointed out, have affiliations in the United States.

By means of international cartel agreements, the German chemical industry has partially regained its former dominance in the world's dye markets. It holds first place in production of synthetic nitrogen fertilizers, producing last year about one half of the world's supply, and shares with France what amounts to a virtual monopoly of the world's potash market. In 1928 nearly a third of Germany's billion dollar output of chemicals went into export trade.

Notwithstanding the fact that Germany is the world's second largest producer of chemicals, its imports of both raw and finished materials in this line have increased markedly. American benzene, turpentine, rosin, sulfur, and phosphate rock enjoy large sales in the German market and appreciable quantities of American sulfur dyes, pyroxylin lacquers, and toilet preparations were also shipped to Germany in 1928. Approximately one eighth of Germany's chemical imports originated in the United States.

Proposes Power from Polar Cold

REGIONS of intense heat, such as the great tropical deserts, have often been proposed as sources of natural power. It has remained for H. Barjot, a Frenchman, to visualize the polar wastes in the same rôle. After all, our conception of "hot" and "cold" are purely relative, and while it would be rash to predict immediate commercial application of the idea, no doubt it is scientifically plausible.

M. Barjot suggests that the water at almost zero degrees beneath thick layers of ice in regions where the air temperature is of the order of 40 degrees might be pumped to the surface and the latent heat (liberated by the water in freezing) used to boil a liquefied gas such as ammonia or, preferably, to remove by boiling a volatile non-aqueous hydrocarbon such as propane from an intimate mixture with water. The fluid could then be used to work a turbine, frozen sea-water or brine providing an efficient and convenient condenser, since the hydrocarbon would be recoverable from the saline liquor produced by fusion. If the mechanical efficiency of the installation is assumed to be four percent, one cubic yard of water would supply energy equal to that produced by the fall of the same quantity of water through 4000 feet.

Mysterious Superiority of "Leviathan's" Steel Plates a Myth

ANOTHER myth in which mysterious superiority was attributed to a product of the skill of German chemists was exploded recently when exhaustive laboratory tests at the United States Bureau of Standards established the fact that the steel plates of the great German-built liner, *Leviathan*, resist saltwater corrosion no better than any other good ship-plate. The statement has frequently been made that

the steel plates used in the construction of the hull of the *Leviathan* have shown in service a marked superiority in resistance to corrosion by sea water to that shown by other ship plate.

Several years ago the results of comparative tests of some of the original steel plates from the *Leviathan* hull and some steel-plate attachments to the hull, added at the time the ship was used for transport duty in the World War, were reported to show the striking superiority of the former. The importance which has been attached to the reports of the outstanding superior quality of the *Leviathan* ship-plate with respect to corrosion resistance is attested by the fact that within the past two years a large American oil-refining company specified that ship-plate similar to that used for the hull of the *Leviathan* should be used.

A series of corrosion tests of mild steels, including some *Leviathan* and other ship-plate, was made by the wet-and-dry and the continuous-immersion methods in sea-salt solutions. The steels varied in copper content from a trace to over 0.60 percent. No differences in corrosion behavior were observed other than those resulting from difference in the test methods employed. The corrosion rate in the wet-and-dry test decreased as the surface film was built up but was always much higher than that for simple immersion.

The laboratory test results have not confirmed in any way whatsoever the claims made for the *Leviathan* plate for unusual superior corrosion resistance. It is believed that differences in the service conditions, the importance of which has apparently not been fully appreciated, will account satisfactorily for the alleged difference in the corrosion behavior of these steels.

Columbium May Come Out of the Museum

AMONG the so-called rarer metals, columbium has as yet found little or no industrial application, although tantalum, with which it is practically always associated in nature, plays an important rôle in the manufacture of dental and surgical instruments, pens, crucibles, electrodes, and electrolytic rectifiers. Tantalum alloys readily with many other metals such as iron, aluminum, molybdenum, titanium, and tungsten. The importance of these alloys lies in their high melting point and great hardness.

Although the properties of columbium resemble very closely those of tantalum, it has received comparatively little attention. Perhaps a partial reason for this has been due to the difficulties involved in the methods available for the extraction of columbium.

A recent investigation of "The Determination of Tantalum and Columbium" conducted at the Rare and Precious Metals Experiment Station of the United States Bureau of Mines, Department of Commerce, in co-operation with the University of Nevada, at Reno, Nevada, makes use

of an entirely new method for the separation of these two elements. It possesses an advantage both in time and expense over the older methods of obtaining columbium free from tantalum. Should this method prove satisfactory for the separation of large quantities of these elements, it should result not only in a cheaper production of tantalum but in the stimulation of interest in columbium and should bring into use one more of the rarer metals, whose properties have been so beneficial to the manufacturing industries.

Sunflower Seeds Supply Russia with Potash

EVERYONE knows that Russia is a tremendous country with rich resources as yet undeveloped; but it will surprise many to know that one of that country's important raw materials is sunflower seeds. Russia is producing 3000 tons annually of carbonate of potash from dried sunflower seeds, according to C. H. MacDowell, President of the Armour Fertilizer Works. That production, although only a drop in the bucket as far as the world supply of potash is concerned, represents "considerable" sunflowers.

World production of potash is steadily increasing, having amounted to 1,600,000 tons in 1927. The United States produced more than 50,000 tons in 1928, which was only one sixth of the total consumption of this essential fertilizer in this country.

Titanium Pigments Invade the Paint Field

ALTHOUGH titanium is far from being the "rare element" many seem to think it to be (it far exceeds in abundance in the earth's crust the "common" metals copper, zinc, lead, tin, and manganese), there are comparatively few uses for it, say A. W. Hixon and W. W. Plechner, writing in a recent issue of *Chemical and Metallurgical Engineering*. Although widely disseminated, the important commercial deposits are more or less localized in Virginia and Florida in the United States, Quebec Province in Canada, in Norway, the east coast of Africa and at Travancore, India.

More recent, and of rapidly increasing importance, is the use of titanium oxide pigments. This development is largely a result of the more exacting requirements of white pigments, induced by competition between the manufacturers of those generally used, that is, white lead, zinc oxide, and lithopone.

Desirable properties in any white pigment are: whiteness; chemical inertness; hiding power; a degree of subdivision which is amenable to control; ability to form with a vehicle mixtures which do not require a large amount of the vehicle merely for the purpose of wetting the pigment; when dried in a thin film that film should be as permanent as possible; on disintegration of the paint film a surface suitable for repainting should be left. Titanium dioxide, alone or combined with inert fillers, possesses these properties to a marked degree.

Paints made with titanium pigments have shown no tendency to crack or peel, but have worn down evenly and uniformly, the surface finally becoming powdery ("chalking") and remaining in excellent condition for repainting. Since a pure titanium oxide paint is inclined to be too

elastic, the addition of zinc oxide as a hardener gives an even more durable paint. Owing to the fact that titanium oxide is a neutral pigment it has no action whatsoever on the vehicle, making a very slow-drying "tacky" paint. This condition is overcome by the addition of zinc oxide or driers.

Since titanium oxide, like the similar oxide of silicon, is the most stable compound of the metal, the pigment is extremely resistant to attack by any of the destructive agencies to which it is likely to be exposed. That it will resist the attack of sulfuric acid, which is notoriously the chief destructive agent in the air of cities, that it is not liable to discoloration by hydrogen sulfide and that it is fully oxidized and therefore is not attacked by sea air or salt water, make it an excellent pigment.

The physical properties of this material further enhance its value as a pigment. Its opacity is greater than that of any other known white pigment.

Corrosion-Resistant Metals Not Immune To Electrolytic Corrosion

THE electro-chemical relation of metals to each other is utilized to protect metals from corrosion. Tin alone would make excellent "tin" cans were it not for its cost and softness. Therefore, it is plated upon an iron base, and as a rule it protects the iron from corrosion brought about by the contents of the can. At a recent Canners' Convention, E. F. Kohman reported that he had made cans from so-called stainless steels, such as chrome steels, chrome-nickel steels, and copper-nickel steels, and that all possessed excellent corrosion resistance when filled with foods which ordinarily give trouble in tin cans. Yet when such cans made from corrosion-resistant alloys were given a tin coating, the cans corroded readily—much more rapidly than ordinary tin cans.

This striking failure of a combination of metals which individually resist corrosion is caused by the electrolytic action which occurs when dissimilar metals are immersed together in a liquid which may serve as an electrolyte.

New Paving Uses Steel Framework

A NEW street paving material, patented in Great Britain and soon to be tried out in Paris, is known as Surfastal and is laid as follows: A concrete foundation about six inches in thickness is first built, upon which is poured a 0.5 inch layer of asphalt. A steel trellis or framework is then placed upon the asphalt, composed of strips one inch in height, 0.125 inch in thickness, and forming squares of about five inches on the side. To prevent displacing before completion of the surface, each square is connected by steel pins.

When this trellis has been set in place, the squares are filled with asphalt and the resulting surface is thus divided into a series of small squares, bounded on each side by strips of steel, connected by steel pins. Since the framework is sufficiently flexible to conform to the profile of the foundation, it becomes an integral part of the wearing surface. The weight of heavy loads, therefore, is supported by the steel framework distributed over a considerable surface area, and the wear on the asphalt is never more than the wear on the edge of

the steel strips, thus reducing maintenance cost to a minimum.

When asphalt or concrete is used in the surface layer, the material contained in each square extends under the steel framework to the contiguous squares and forms a homogeneous mass, separated on the surface only by the steel strips to a depth of one inch.

Furfural Becomes a Staple Commodity

THE production of furfural by scientists in the United States Department of Agriculture at Washington is cited by the Institute for Government Research, in a recent monograph on the Bureau of Chemistry and Soils, as an example of how the agricultural chemists have converted various farm wastes into useful articles of commerce. Furfural is made from oat hulls and corn cobs, and is widely used as a solvent.

Although farm wastes contain pentosans, and pentosans may be converted to furfural by a simple acid distillation, the institute points out that the government's chemists were the first to produce furfural on an important commercial scale.

"The present American output of furfural," the Institute's publication says, "is more than a half million pounds, with an average selling price of 10 to 17 cents a pound. Before 1922, when the color laboratory of the Bureau of Chemistry and Soils started work on the production of furfural, it was a chemical curiosity valued at 30 dollars a pound."

Sulfur Dioxide Health Hazard Exaggerated

THE increasing use of liquid sulfur dioxide in small refrigeration units has caused considerable attention to be given to its effects on people who might breathe it. Apparently no really serious scientific study along these lines has yet been made, says *Chemical Markets*. References in medical literature are probably to tests using gases such as exist around smelters, which may contain, besides sulfur dioxide, other chemicals.

Several, if not all, medical references to the subject carry the same statement that "On the membranes of the nose and throat sulfur dioxide forms sulfuric acid." If sulfuric acid is formed, it is formed only to an extremely small extent. No such modifying statement appears, so that it can readily be seen how badly misled anyone may be who is interested in trying to learn what to expect when he, or his friend, or client, has breathed sulfur dioxide.

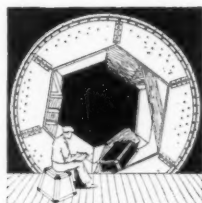
Everyone can picture all too vividly what sulfuric acid would do to the membranes of the nose and throat, but few can be expected to know that, if formed at all from sulfur dioxide, this sulfuric acid is formed to an extremely small extent, and hence that any injury from sulfuric acid so formed is almost impossible. It seems quite probable that these references in the medical literature were intended to read "sulfurous acid" and not sulfuric acid. Sulfurous acid (H_2SO_3) is sulfur dioxide in water. Its properties are decidedly different from sulfuric acid.

One other point on what has been written about the effects of sulfur dioxide, and that is, while the data given show serious effects or even death after breathing gases containing certain volumes of sulfur dioxide,

(Please turn to page 87)

How this grainless wood started a box maker in the toy business

Here are the facts about a box maker who improved one product, developed another and cut material waste to 2% by adopting Masonite Presdwood. In scores of other industries this grainless wood has proved equally profitable. Perhaps you, too, can employ it to advantage. Samples for test gladly supplied.



THE LEWIS TEST DRUM

Striking sharp steel projections in the revolving test drum, dropped 4,193 times before it broke, a Masonite Presdwood box, with light sheet metal covering, proved itself vastly superior to a similar box of all-steel construction. The test resulted

in the adoption of this grainless wood by the G. B. Lewis Company of Watertown, Wisconsin, for use in its Multitrip Boxes. Then it was found that the scraps from the box factory were ideal for toys.

No cross grain in Presdwood

These smaller pieces of Masonite Presdwood were really scraps in size alone. Toys of this grainless material are ideal for small children because of freedom from splinters. Resistance to warping insured durability for toys that might be left out of doors. The naturally attractive appearance of Presdwood was recognized as a sales asset not to be passed by lightly.

Thus is explained the appearance of Arkitoy construction sets in the toy shops and department stores last Christmas.

But Presdwood does much more than build strong boxes and light toys. It panels ceilings of railroad coaches and the salons of steamers. It serves in hulls and decks of fast hydroplanes and makes sturdy side panels for motor trucks.

Where outdoor signs are made in quantities you will find it ordered by the carload because of its ability to stand the weather and take any paint finish.

It panels walls and ceilings of fine homes and adds an air of distinction to corridors and offices of stately buildings. It builds strong partitions and light shelving; lines closets and elevator shafts. Where builders want a specially fine surface on the outside of a building they use Presdwood to line the concrete forms.

Production managers like to use it in the factory. Home mechanics find it handy to have for odd jobs around the house.

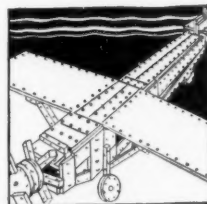
Never harms fine tools

This easily worked material never harms good tools for it is made entirely of wood—contains no artificial binder. It comes in 4-foot by 12-foot boards, either $\frac{1}{8}$ inch or $\frac{3}{16}$ inch thick. It can be punched, die-cut, milled or sawed.

Builders, factory executives and home owners should send for the booklet which tells the fascinating story of Presdwood and beautifully illustrates many of its uses.

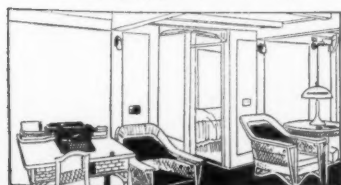
MASONITE CORPORATION

Dept. 739, 111 West Washington Street
Chicago, Illinois



FOR MAKING ARKITOYS

FOR STEAMBOAT PANELING



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Masonite
PRESWOOD
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MASONITE STRUCTURAL INSULATION
REG. U.S. PAT. OFF.

FOR CEILINGS OF RAILWAY COACHES



Current Bulletin Briefs

Short Reviews of Bulletins and Papers on Scientific and Allied Subjects, and Where to Get Them

Aviation

AIRPORT ILLUMINATION explains the lighting requisites for landing fields and routes. Numerous photographs and diagrams show examples of proper illumination under a wide variety of situations. The design and illumination of air marking signs is also discussed, with recommendations for an adaptable scheme of lighting. *General Electric Company, Schenectady, New York.—Gratis.*

Commerce

A REVIEW OF RAILWAY OPERATIONS IN 1928, by Julius H. Parmelee, discusses the significant traffic trends during the year, particularly the sharp upturn in freight traffic during the fall months after a half year of rather discouraging deficiency in carloadings. The present satisfactory state of the railroads is credited to their program for improvement. *Bureau of Railway Economics, Transportation Building, Washington, D. C.—Gratis.*

THE TRADE AND RAILWAY OUTLOOK, by R. Bell, reviews recent railway events and tendencies in Great Britain, America, Germany, and elsewhere in an interesting and stimulating manner. *London and North Eastern Railway Works, Stratford, England.—Gratis.*

INTERNATIONAL TRADE IN FURS, by Thomas J. Biggins, deals with the production of furs in the United States, and domestic and foreign trade in skins and furs. *United States Government Printing Office, Washington, D. C.—10 cents.*

FRENCH AND GERMAN INLAND WATERWAYS, Trade Information Bulletin No. 597, reviews the growth of the French and German waterway systems, with numerous comparisons. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

RADIO MARKETS OF THE WORLD, Trade Information Bulletin Number 600, deals with conditions which affect radio broadcasting and reception in different parts of the world, and discusses the markets for radio apparatus and the regulations governing its use in various countries. *U. S. Government Printing Office, Washington, D. C.—10 cents.*

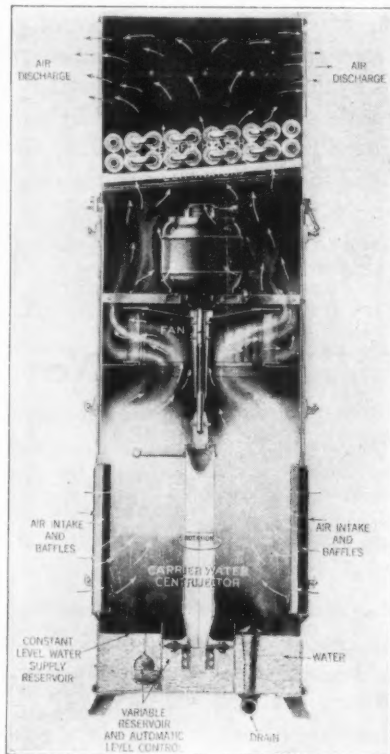
Education

A BIBLIOGRAPHY OF GEOGRAPHICAL LITERATURE FOR ELEMENTARY GRADES AND JUNIOR HIGH SCHOOL, by Ella B. Knight, is a well-indexed bibliography of the literature of geography. It is designed to acquaint classroom teachers with the nature and sources of a wide variety of supplementary instructional material for geography classes. *Department of Geography, Clark University, Worcester, Mass.—25 cents.*

ANNUAL REVIEW OF LEGAL EDUCATION contains an up-to-date list of law schools in the United States and Canada, with data about their courses, tuition fees, and student attendance. Another valuable list presents pertinent data regarding bar admittance requirements for each state and province. *Carnegie Foundation for the Advancement of Teaching, 522 Fifth Avenue, New York City.—Gratis.*

Industry

MANUFACTURED WEATHER IN THE PRINTING AND LITHOGRAPHING INDUSTRIES shows how troublesome variations in temperature



Courtesy Carrier Engineering Corporation
Phantom view of a unit air conditioner, showing how the air is cleaned, given proper temperature and humidity, and then circulated

and humidity can be removed from a plant by means of proper air conditioning equipment. *Carrier Engineering Corporation, Newark, N. J.—Gratis.*

RAYON—A NEW INFLUENCE IN THE TEXTILE INDUSTRY is a well prepared booklet of information and statistical tables showing the development of the rayon industry

and the market for rayon products in the United States. *Policyholders' Service Bureau, Metropolitan Life Insurance Company, 1 Madison Avenue, New York City.—Gratis.*

SIMPLIFIED PRACTICE, WHAT IT IS AND WHAT IT OFFERS, is a summary of the activities of the Division of Simplified Practice of the Department of Commerce. A detailed description is given regarding the services offered to various American industries. *U. S. Government Printing Office, Washington, D. C.—15 cents.*

THE MANIT SYSTEM contains information regarding the standard man-minute of work, by which many organizations have been able to save an average of 21 percent on their payrolls while increasing wages to employees by an average of 17 percent. *Haynes Corporation, First National Bank Building, Chicago, Illinois.—Gratis.*

POWER PLANT INSTRUMENT DATA BOOK provides information from which a suitable plan of instrument equipment may be easily worked out for any steam plant. The applications cited are presented from the viewpoint of operation, for measuring temperatures, pressures, flows, liquid levels, percentage of carbon dioxide, and speeds. *Brown Instrument Company, Philadelphia, Pa.—Gratis.*

Mining

TEN DECISIONS ON IMPORTANT MINE SAFETY PROBLEMS, Information Circular 6091, supplements the handbook "Safety in Coal Mining," published by the Bureau of Mines some time ago. The decisions were made by the Mine Safety Board to define the Bureau's collective opinion as to safety practices, safety devices, or safety methods for underground and open-pit mining. *Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.*

LIST OF PERMISSIBLE MINING EQUIPMENT, Bureau of Mines Information Circular 6097, includes equipment for mines that has been tested and approved with special reference to safety features. The system under which the devices are tested permits the manufacturer, whose product conforms to minimum requirements for safety in use, to mark his equipment with a seal showing that it has been approved by the Bureau. *Department of Commerce, Washington, D. C.—Gratis.*

MUDITING TO PREVENT EXPLOSIONS IN COAL MINES, Information Circular 6099, contains the results of an investigation of the Bureau of Mines. The circular shows that while muditing is probably more dependable than watering, especially in haulage-ways which also act as intake air ways, it is probable that adequate rock-dusting methods would be more dependable and less

expensive. Bureau of Mines, Department of Commerce, Washington, D. C.—Gratis.

Research

A DIRECTORY OF RESEARCH ON HEAT TRANSMISSION IN THE EDUCATIONAL INSTITUTIONS OF THE UNITED STATES is a compilation that will be of interest to all concerned with heat transmission. It is a good example of the plan of correlation and appraisal of various research activities that is being followed by the National Research Council in several industrial fields. Committee on Heat Transmission, 40 West 40th Street, New York City.—Gratis.

A HIGH-PRESSURE GAS-COMPRESSION SYSTEM, Circular No. 61 of the United States Department of Agriculture, describes and illustrates how to make an apparatus for research work with gases at normal temperatures and at pressures up to 1500 atmospheres, or about 22,500 pounds per square inch. Detailed drawings of each piece of equipment are shown, and approximate costs are included with the description of the apparatus. U. S. Government Printing Office, Washington, D. C.—10 cents.

Miscellaneous

OPPORTUNITIES FOR CHEMISTS IN THE UNITED STATES CIVIL SERVICE shows that the government employs more chemists than any other organization in the world. Full and complete information is given regarding salaries, requirements, examinations, and the various governmental agencies in which chemistry plays an important role. United States Civil Service Commission, Washington, D. C.—Gratis.

KEY-CATALOG OF INSECTS OF IMPORTANCE IN PUBLIC HEALTH, United States Public Health Service Hygienic Laboratory Bulletin No. 150, is a condensed, systematized compilation of the data of entomology as they apply to public health. About a thousand entries are alphabetically arranged and cross indexed with brief notes under such headings as parasites, pests, and biting, poisonous, and stinging insects. U. S. Government Printing Office, Washington, D. C.—20 cents.

THE KICKING HORSE TRAIL, one of several handsome little booklets designed to lure the motorist to the Canadian Rockies, describes the scenic highway from Lake Louise, Alberta, to Golden, British Columbia. For those who have the wherewithal and the withal for a vacation to be remembered forever, this booklet will solve the problem. But if you go to the northwest for a vacation, don't overlook the Waterton Lakes country, and our own Glacier National Park. The Department of the Interior, Ottawa, Canada.—Gratis.

THE CONTROL OF FLOODS BY RESERVOIRS, BULLETIN 14, by Paul Bailey, is a 463-page appendix to the summary report to the Legislature of 1927 on the water resources of California and a co-ordinated plan for their development. The entire volume is given over to an analysis of the possibility of co-ordinating programs of flood control and conservation. Department of Public Works, State of California, Sacramento, California.—Gratis.



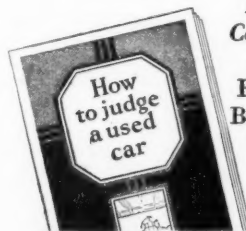
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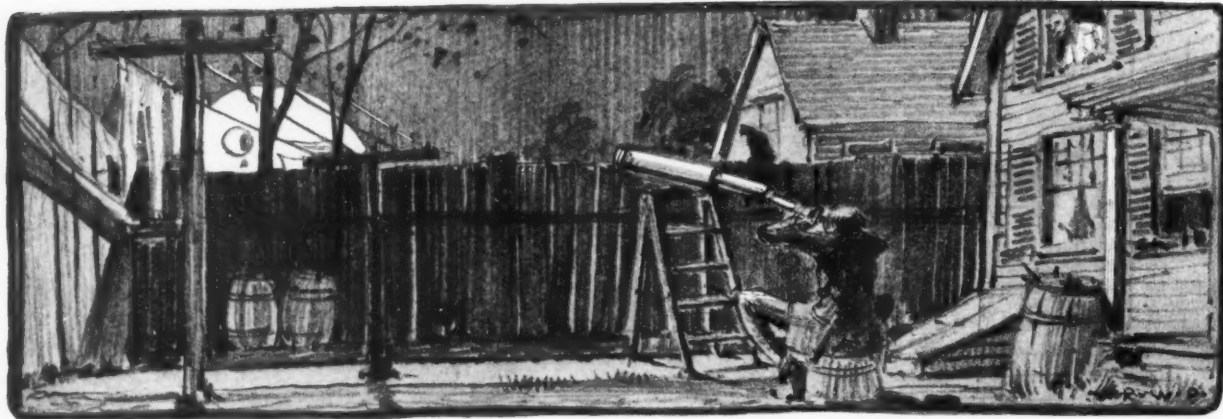
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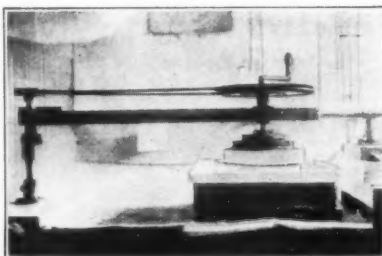
AS explained in Part V of the book "Amateur Telescope Making," which treats of automatic machines for those who prefer not to perform the customary hand work of making the concave mirror of a reflecting telescope, a machine is not a necessary adjunct to the telescope maker's shop; not one amateur out of a hundred uses one. Some, however, really enjoy designing and making a machine, and to such the illustrations reproduced in these columns may prove of interest.



Moore and his two co-workers

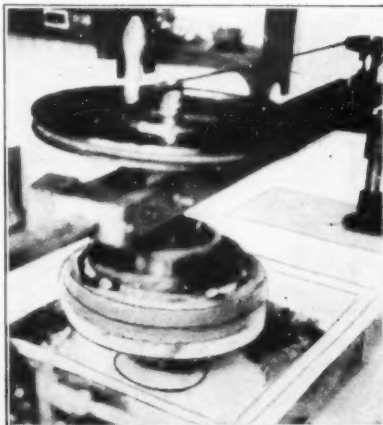
F. Moore, 1021 Pemberton Road, Victoria, B. C., Canada, sends in three photographs, one showing two friends and himself with several interesting exhibits of machine work as added scenic features. Mr. Moore is rather short on words—all he writes is: "I enclose photos of a grinding machine I have constructed. On it an 11-inch speculum is being completed. The 2½-inch achromatic object glass for the finder and the lenses for the eyepieces were also made on it." Evidently Moore and his friends have been making something quite elaborate in the way of a telescope, short of a 200-inch. We hope they will some day favor us with a picture of the complete job.

MR. FRANK G. MILLIGAN, 715 Ravenna Road, Seattle, Washington, writes as follows: "Enclosed you will find photographs of a vertical grinding lathe I built for grinding and polishing my eyepiece lens and prisms. The main gear wheel is eight inches in diameter with 50 teeth, and there are two screw threads on



Moore's grinding machine

the worm. The bearings are made of steam fittings. Three bearings are made of 1½ inch by ¾ inch pipe crosses. The main bearing for the vertical shaft is made of a 3 inch floor flange, with a close nipple sawed in half and screwed into the flange. In the nipple is set a small ball bearing embedded in babbitt metal, and the end of the shaft is turned down to fit into the ball bearing. The upper end of the shaft is turned to a cone to fit the grinding flat. The vertical shaft is 8½ inches long, and the horizontal shaft carrying the screw is 12 inches long. Both shafts are made of one inch cold rolled shafting. I picked up the gear and worm in a second-hand machinery depot. The motor runs at 1750 r.p.m. The drive pulley is 2 inches, and the driven pulley is 4 inches, in diameter. The main gear makes 35 r.p.m. and revers-



Another view of Moore's machine

ing the pulleys gives 140 r.p.m. The vertical lathes used by opticians grinding eye-glass lens run 940 r.p.m.

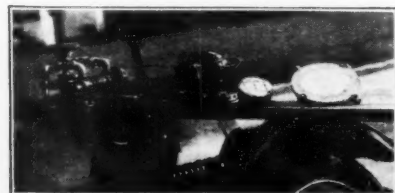
DR. K. NAKAMURA (see "A. T. M.," page 225, at bottom) of the Astronomical Observatory of the Kyoto Imperial University, Kyoto, Japan, writes: "The new edition of 'Amateur Telescope Making' reached me safely. I find the book is nearly completely perfected and now the best book of its kind. I feel interest to find my words on page 226. Since the August of 1926, there are thousands of mirror workers in Japan. Most of them were young students of 'teens age, which seems to be somewhat different compared with most American workers."

"I have enclosed a print of my grinding and polishing machine. The original design of this machine was by Mr. Hindle and appeared in *English Mechanics*, 1923. The machine is simple and easy to construct. It has some defect of producing hill at the center of the mirror, but nearly spherical surface is easily attained when the pitch condition is perfect. But the figuring must be done by hand. I am now working on my 130th mirror."

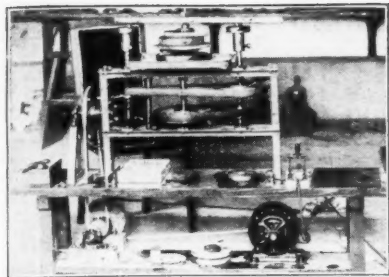
To this the editor replied, inquiring whether it might be thought advisable to advertise "A. T. M." in Japan. Some weeks later the following answer was received:

"Thank you for your kind letter. There is a book written about the mirror making by Mr. Yamasaki, published in 1926. I have written one recently which is expected to be published in next May. But some of the Japanese amateurs are requesting good foreign book. Therefore you can increase its sale. The Maruzen Company is the best and largest shop of foreign books."

"The Hindle's grinding and polishing machine is a good one but it still requires improvement. It is similar in principle to Ritchey's machine but is improved. My



Milligan's simple machine



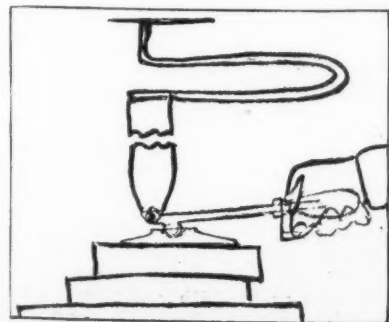
Dr. Nakamura's machine. A six-inch mirror can be completed, except the figuring, in seven hours

present one is one third dimension of original design. But I am now determined to make double sized one. I wish to add interchangeable straight stroke. I have recently polished several convex surfaces of object glass, with unexpected success. Although good surfaces depend on the best pitch, the interference test proved good spherical surface free from zones, without figuring.

"I start here for Sumatra on March 24 for the observation of total eclipse."

AMATEURS who like to experiment may try out the suggestion contained in Porter's sketch, which we reproduce, of a "dingbat" for applying pressure to a mirror during grinding. The Tel. Ed. first picked up the idea from watching a Chinese laundryman who was using a similar rig "for pressee hardee on shirtee." It consisted simply of a six foot vertical pole with a spring at the top attached to the ceiling, and a point at the bottom. This engaged with a depression in the flat-iron. The idea was sent to Porter who elaborated it as shown, saying he would try it out. Just then he was given a chance to try out something rather more important, as we all know, in California, and therefore it is hoped that someone else will try this stunt and report (1) whether it works, (2) whether it results in any net gain in time and temper.

IN addition to amateur telescope making there is another amateur hobby, at present undeveloped, which it is hoped may some day be taken up and if possible popularized in the SCIENTIFIC AMERICAN. That is, seismology. Several seismologists have expressed interest in the suggestion that amateurs be encouraged to construct inexpensive apparatus for recording earthquakes. In addition to genuine quakes there are other interesting local disturbances due to automobile traffic, blasting, railroads, vibrating factories, and so on. As Dr. T. A. Jagger, volcanologist at the



Proposed "Chinee" grinding rig

THE PHILOSOPHY OF INDIVIDUAL LIFE

"Philosophy," from the Greek, "philo," meaning "loving, fond of, attached to" and "sophy" meaning wisdom. From this we may conclude "Philosophy" to mean being attached to, or fond of, Wisdom in the affairs of life.

No philosophy of life can appeal unless it is based on a scientific foundation. It must consist of logical principles built up on a basis of known facts. It must be founded on natural laws, each susceptible of proof.

Ethically considered, there are but two fundamental principles in Nature. In their relation to the Individual the one is constructive, or what we are accustomed to regard as "normal," and the other destructive, or what we are accustomed to regard as "abnormal." Every fact of Nature, whether scientific, philosophic or otherwise, aligns itself as a direct result of one or the other of these two fundamental principles in operation.

The problem of the Individual is that of identifying these two principles in their relation to the objective facts of life so that he may be able to conform to the one and avoid the other.

It may be conceded that the fundamental and essential elements of Individual responsibility are Self-Consciousness, Independent Choice, Reason and Independent Rational Volition. To these distinctive human possessions Science turns for the key which unlocks the door to Individual Accomplishment, for these are the inherent elements of human character.

According to THE PHILOSOPHY OF INDIVIDUAL LIFE, each Individual possesses, through proper use of these essentials, the power which enables him to adjust known scientific facts with natural law and thereby achieve greater understanding of life and living.

There is in Nature that which integrates physical matter and builds it up into individualized forms. It manifests itself to the objective senses in the integration and crystallization of stone. It is evidenced by the subtle force which integrates and binds together in solid mass the particles of various metals. It is

observed in the condensation of vapors into liquids and of liquids into solids.

This integration and growth automatically responds to natural law in its manipulation of physical conditions. On the physical plane it takes hold of physical matter and integrates it, building it into Individual Form. On the intellectual plane it builds up Individual Intelligence. On the ethical plane it builds up Individual Moral Character.

As far as it has been possible to trace the authentic history of mankind, human Intelligence has intuitively sensed a great fundamental law underlying all these manifestations of Nature.

This fundamental law, back of the process which integrates inorganic matter and organizes vegetable and animal matter into living, organic bodies, constitutes the essential foundation of all natural development and growth in Individual Life.

What may be the ultimate goal, then, of Individual Achievement undertaken in accordance with known scientific facts harmonized with this fundamental law?

To answer this logically there has been prepared for the GREAT SCHOOL OF NATURAL SCIENCE a series of unabridged volumes. In these volumes the established facts of Science are correlated with natural law and applied to a sane and logical method of scientific Self-Development for the Individual Intelligence.

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THE GREAT CRIME: The destructive principle in Nature.

THE GREAT WORK: The constructive principle in Nature.

THE GREAT KNOWN: Aspects of Natural Science relative to life under various conditions.

THE GREAT MESSAGE: The historic basis on which the Philosophy of Individual Life is founded.

SELF-UNFOLDMENT: Scientific principles of Nature and how they may be logically proven.

WHO ANSWERS: A brochure explaining methods by which results are obtained.

These volumes are distributed by the Pioneer Press, Dept. 512, Hollywood, California, on receipt of \$12.50 full payment or \$5 first payment. They may be kept and read five days before deciding whether or not you wish to own them. At the end of that time the volumes may be returned, upon which all money deposited will be immediately refunded in full, or if they are retained and a five dollar first deposit has been made, the balance of seven dollars and fifty cents should be forwarded.

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R. R. BENNETT

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Lt. Colonel, Air Corps Reserve

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formerly Chief Aeronautical Engineer, U. S. Army

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Hawaiian Volcano Observatory of the United States Geological Survey, states, "To record every car that passes, its weight and speed, would be quite possible with a seismograph. As to making an instrument for 50 dollars or less, that would be easy for a mechanic." A simple instrument has been described in one of the scientific journals.

At present there is no textbook on seismology suitable for the amateur, Hobbs' being rather old and Davison's being elusive in treatment. However, a noted seismologist is known to have a text book in preparation. Seismology as a hobby—in fact, any other hobby we

know of which is suitable for readers of a scientific journal—could hardly compete with amateur telescope making; and the latter will not be dropped until there are signs that its hold is weakening—which certainly is not yet. Several have suggested that a special department of this journal be regularly devoted to all kinds of hobbies. This would possibly prove interesting, but where is the many-sided editor who is to run such a department, and where would the line be drawn? The number of hobbies is almost infinite.

How many readers of this journal would take an interest in amateur seismology and will write in to say so?—A. G. I., Tel. Ed.

The Heavens in July

By PROF. HENRY NORRIS RUSSELL, Ph.D.



At 11 o'clock: July 7.
At 10½ o'clock: July 14.
At 10 o'clock: July 22.

At 9½ o'clock: July 30.

At 9 o'clock: Aug. 7.
At 8½ o'clock: Aug. 14.
At 8 o'clock: Aug. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on July 7, etc.

NIGHT SKY: JULY AND AUGUST

MERCURY is a morning star, being at greatest elongation 21 degrees from the sun on the 3rd. Through the first half of the month he rises about 3:30 A.M. and should be easily visible. Then he closes in rapidly toward the sun and is in conjunction with him on the 31st. Venus is a morning star, rising about 2 A.M., and is very conspicuous. Mars is still in the evening sky and sets about 9:30 P.M., but he is no longer a prominent object. Jupiter is a morning star and is close to Venus. The planets are in conjunction on the 14th, and only 2 degrees apart. At this time they are in Taurus, only a few degrees from Aldebaran, and the three bright objects will form a very pretty picture. Saturn is in Sagittarius and comes to the meridian near 10 P.M., in the middle of the month. His

rings are seen at their widest angle and, although so far south, he is a fascinating telescopic object. Uranus is in quadrature west of the sun on the 3rd, and is observable in the morning. Neptune is an evening star and is too near the sun to be easily observed.

The moon is new at 4 P.M. on the 6th; in her first quarter at 11 A.M. on the 13th; full at 2 P.M. on the 21st; and in her last quarter at 8 A.M. on the 29th. She is nearest the earth on the 6th, and farthest away on the 19th. During the month she is in conjunction with Venus on the 3rd, Jupiter on the 4th, Mercury on the 5th, Neptune on the 9th, Mars later on the same day, Saturn on the 18th, and Uranus on the 27th.—Princeton University Observatory.

The Month in Medical Science

(Continued from page 76)

There are a thousand different kinds of cockroaches, more or less. Four are domesticated and are happy around a home. They vary from the rather small reddish insect found in many American kitchens and basements to the German cockroach called the croton bug. This is the slipperiest, quickest, smartest, and meanest of the lot.

Cockroaches, like some human beings, do most of their wandering at night, soiling everything they touch and leaving a permanent nauseating odor. They migrate from one apartment to another, following water and drain pipes from cellar to roof, at least in apartments of moderate height.

Tularemia from the Muskrat

TULAREMIA, the infection first discovered in field mice and later in sick rabbits, then found to affect human beings, has now been found also in the muskrat. A physician of Montana has reported two cases in human beings resulting from skinning muskrats to obtain the pelts. It has not been definitely established just how the muskrat gets the disease, but undoubtedly its association with the rabbit and with other small animals is sufficient to explain the situation.

Reflex Itching in Asthma

IT is not at all unusual for an asthmatic person to complain of intense itching of the eyes, nose, roof of the mouth, back of the throat, and even the ears. Recently Dr. R. M. Balyeat has found an associated itching of the skin of the patient in certain areas. In four cases of asthma which he studied with this point in view, the itching seemed to be the result of stimulation of the nerves of the skin, due to association of these nerve roots with those of the nerve roots coming from the lung. The symptom of itching of the skin of the chest was present in 13 out of 420 patients.

In one case, a woman was sensitive to chicken and goose feathers, to western water hemp, and to ragweed. The elimination of feathers from the home and desensitization against the weeds brought her relief not only of the asthma but also of the itching of the chest. Another woman with hay-fever and asthma was found to be sensitive to duck feathers, dog hair, cat hair, and the pollens of ragweed. The elimination of the substances to which she was sensitive, and desensitization, relieved her also of the itching, although some of the asthmatic symptoms still remained.

Apparently in such cases the itching is definitely associated with the sensitivity to various substances, and the relief of the disease itself serves equally well to relieve the itching.

Blindness Caused by Battery Fluid

BBATTERY fluid is composed of sulfuric acid and water. Sulfuric acid is a caustic substance which may seriously injure any tissues with which it comes in contact. A report has recently been made available which indicates how dangerous such acid substances may be to the eye. In an automobile accident, a woman was pinned underneath an overturned coupé in such a manner that the fluid from the battery ran into both her eyes and into her



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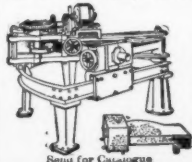
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mouth and throat. By the time she was taken to the hospital, the eyes were so badly burned that it was impossible to do anything to save her eyesight.

The usual treatment for caustic burns of the eye involves thorough washing with sterile water, the application of olive oil or some bland oil, and the placing of ice cloths to the lids for four or five hours. Later, heat is substituted for the cold. Many authorities state that one drop of nitric or sulfuric acid is sufficient to destroy the eye.

The physician who reported the accident here mentioned suggests that mild solutions of baking soda might be preferable to ordinary water for washing the eye after an acid burn, since these would tend to counteract the effects of the acid.

The Slanting Eyes of the Chinese

IT has been the impression for years that the eye of the Mongolian is oblique. A recent investigation indicates that this is more apparent than real and that the opinion has been fostered by the traditional fondness of Mongolian artists and Caucasian actors for this style of countenance. Thus an actor who is making up as a Chinese exaggerates the impression of obliquity of the eye by painting an upward and outward extension of the eyebrows.

Dr. H. Gifford, after a study of 340 photographs of Chinese and Japanese and of 500 natives in Kioto and Yokohama, considers the notion of the special "mongolian eye" as much exaggerated. The most common and striking characteristic of the mongolian eye is some narrowness of the opening, combined with the result of a fullness and width of the space below the eyebrow and the margin of the fissure. A rudimentary eyelid, in the shape of a fold extending from the skin of the upper lid obliquely downward and inward to the bridge of the nose and persisting through life, seems to be much more common among Mongolians than other races.

Effects of Emotion on Digestion

FOR many years physicians have known that emotional states affect the secretion of the juices of the stomach and bowels and thereby digestion. Recently Dr. W. C. Alvarez has reviewed the available scientific literature on this subject in the light of cases that he has seen himself. More and more it is being realized that eating during times of strong emotion is not desirable and that appetite is dependent as much on mental factors as on physical. An old proverb has it that a dry morsel and quietness therewith is better than a houseful of feasting with strife.

Alvarez suggests that meals be postponed until strong emotions have passed, calm has been restored, fatigue lessened, and appetite returned. When a person is really interested in food, the stomach and intestines begin to secrete and the muscles begin to move things onward. When this motion does not regularly occur, attempts must be made to interest the patient in the food, and to give him things that are appetizing, and to allow him to smell, taste, and chew food.

For reverse action, such as occurs with heart burn, belching, hiccoughs, and similar forms of distress, it is suggested that these motions can be stopped and driven downward by swallowing rapidly, by sipping water, or by chewing gum.

The Study of Criminology

is receiving more and more attention by students of sociology and betterment investigators.



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Chemistry in Industry

(Continued from page 78)

no mention is made of the fact that as sulfur dioxide even in small quantities is so irritating, no one would breathe such a concentration unless they were so trapped they could not get away. Because a leak of sulfur dioxide makes itself so quickly and distinctly known, sulfur dioxide is often called a "safe gas." There is no chance, with sulfur dioxide, of one being killed as he sleeps, yet references in medical literature might so be construed by those who to-day, because of widespread use in small refrigeration machines, look up these references.

New Arc Light Carbons

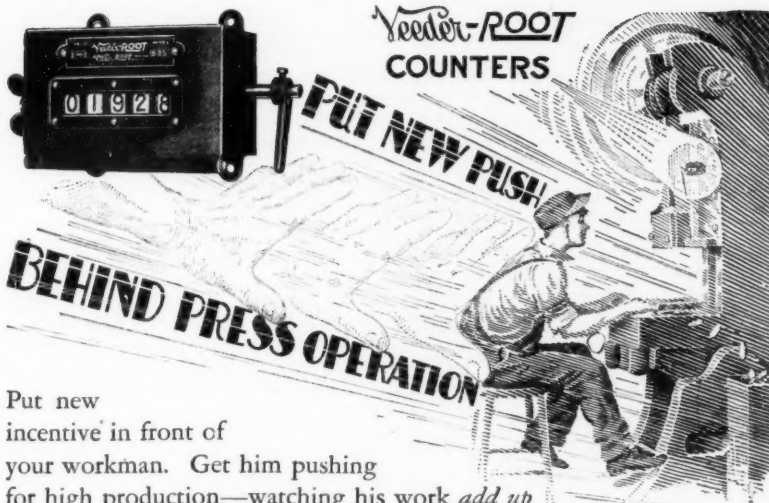
TO rival the sun has long been the objective of artificial illumination, but great as have been the strides made in electric lighting, the man-made light always lacks some of the qualities of Old Sol's output. A light that is hailed by a government bureau as "the closest approximation to natural sunshine" has recently made its appearance and it depends for its unique properties on the chemical treatment of the carbon pencils used to make the arc. The National Carbon Company is marketing this line of new ultra-violet ray lamps and carbons, which will be sold under the Eveready trademark. A new type of cored carbon has been developed, impregnated with rare earths and minerals. When burned electrically in pairs, the resulting light is said to have many of the valuable properties of sunlight.

Grading Cottonseed by Analysis

A NEW method of grading cottonseed by chemical analysis has been developed by G. S. Meloy, marketing specialist of the Bureau of Agricultural Economics. The old standard was based on the average value of seed as determined for various producing areas. As oil and protein content may vary as much as 25 to 50 percent and kernel content from 45 to 65 percent, need has been felt for a method applicable to separate consignments giving a price incentive to quality production. Oil is the most important factor in price determination. Since the ratio of oil in the kernel is in inverse proportion to that of protein, the problem would be fairly simple if extraction of perfect kernels were possible. Under present conditions, however, it is necessary to work with data obtained from a chemical analysis of the entire seed.

Expansion Effects in Concrete Explained

USEFUL as concrete is, in modern construction and industry, there are shortcomings which chemists now strive to eliminate. It is predicted that a better appreciation of the chemistry of concrete and special forms of cement will open entirely new fields of utility for this material. Thus, recent investigation has revealed among the reaction products formed by the action of sulfate waters on Portland cement, a calcium sulfoaluminate, thought by some investigators to be responsible for certain expansion effects sometimes observed in concrete. The exact nature of this compound, its condition of formation, and stability have been studied by the Portland Cement Association and the De-



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partment of Commerce. This compound is formed by the interaction of sulfates with lime and aluminates. It is relatively stable in water, but is decomposed by solutions of magnesium salts and of carbonates. A second calcium sulfoaluminate of lower sulfate content is relatively unstable and is consequently believed to have no significance in concrete.

Metaldehyde Developed As Fuel In Germany

REPORTS from Germany say that the Lonz Electric Works have brought out a new fuel under the name "Meta." (See SCIENTIFIC AMERICAN, December, 1928, page 537.) Chemically it is metaldehyde and is produced first by the action of water on acetylene in the presence of mercury compounds. The resultant acetaldehyde is then treated with sulfuric acid in cast-iron vessels at 150 degrees, Centigrade, and metaldehyde is obtained. The heat value of Meta is 6136 large calories per kilogram.

Soap Improves Concrete

THE effect of soap as a water-proofing material for concrete has recently been investigated in Great Britain. For this purpose a comparatively small quantity of soap, amounting to about 0.05 percent of the weight of the concrete is necessary. The soap imparts impenetrability to the concrete by reason of its colloidal swelling in the pores on the surface of the concrete. For a successful product it is necessary that the concrete should not be allowed to dry too quickly. It should be kept damp for at least seven days. This assures against any weakening effect on the concrete, the usual increase of strength being observed after the concrete dries. The usual precautions, however, must be taken to prevent cracking as the soap is not effective in preventing the ingress of water through cracks.

What is pointed out by a writer in *Concrete* as a very considerable advantage derived from this method of water-proofing, is the fact that a block of plain concrete wet on one side expands and gives rise to internal stresses which tend to diminish its strength. The addition of soap, preventing the admission of water, provides some guarantee against this weakening from wetting.

Nitrogen Gas Cuts a Freight Bill

"SOME years ago it was found that silver-ware tarnished in transit" says Arthur A. Maas, writing in his bright little house-organ *Chemistry and You*. "The difficulty was traced to tissue paper, in which the silver was wrapped—chemical analysis showed that it contained sulfur, and we all know what the sulfur in an egg does to a silver spoon.

"The chemist frequently finds work in the shipping room. For example, electrical transformers have been shipped filled with oil, to prevent damage by atmospheric moisture in transit.

"Recently, a large electrical company found that the addition of the oil to some huge transformers made for California would result in too great weight. What could be used, which would fill the bill, and yet be light enough? Chemists answered that question by filling the sealed transformers with nitrogen, at three pounds

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pressure. The apparatus reached California in perfect condition, with one and a half pounds pressure of the gas still remaining. And the freight bill on nitrogen was—nothing!"

Imitation Ice for Skating

THERE has recently been developed in Germany a new process for the construction of skating rinks using a floor prepared from chemicals rather than with ice. Although this process is new, it has already been tried out commercially, and the installations to date have been moderately successful, it is claimed.

According to James E. Wallis, trade commissioner, the chemical composition used appears to be soda ash with certain other chemicals added to prevent its solution in water. The ordinary material as it appears on the floor of the rink has the appearance of an almost opaque dirty ice, or may more accurately be described as having the appearance of crude rock salt as it comes from the mines.

Synthetic Building Stone Predicted

HOMES built of coal by-products and permanently tinted in any color of the rainbow were among the wonders predicted recently by Dr. Gustav Egloff and Dr. J. C. Morrell.

"The material is in commercial use," the paper said. "Chemically it is called hexatetramethylenamine. To get it, we take the high boiling tar acids obtained by processing coal and crack them to form carbo-lic acid. To this we add formaldehyde and ammonia, and obtain the material. Add iron oxide and you get a red material. Add titanium oxide and the resultant color is a beautiful blue. Other dyes and colors may be added, singly or in combination, to obtain the desired colored effect.

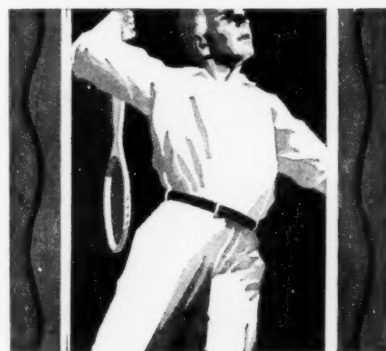
"This material is impervious to water, highly resistant to atmospheric corrosion, is a non-conductor of electricity and can be produced cheaper than the granite now used to veneer high steel buildings."

First Aid For Chemical Burns

NO course in first aid is complete these days without some knowledge of the emergency treatment of chemical burns. Such burns may be classified according to acid or alkali source, the former including burns from nitric, sulfuric, muriatic, acetic, oxalic, hydrofluoric, picric, carbolic, and chromic acids. The latter are represented by caustic soda and potash, lime, ammonia, and soda ash.

It is always desirable to determine first whether a burn is acid or alkaline. Litmus paper, wet in water should be used. In either case, then, the burn should be well flushed with water after which it is to be neutralized, in case of acid, with a 10 percent soda solution, and in case of alkali, with weak vinegar (or dilute acetic acid). The bathing of the spot with the neutralizing solution should continue for some minutes. The dressing to be used after neutralization is identical with that for ordinary burns. In certain cases, special treatment is recommended. Chromium burns require immediate treatment with sodium hyposulfite solution. Phenol burns should be washed freely with clean water after which alcohol is applied. Prussic acid burns should be bathed freely in hydrogen peroxide after flushing with water.

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Commercial Property News

Facts and Notes of Interest to Inventors, Patentees, and Owners of Trademark Rights

For Sleepy Copyright Owners

THE inexcusable delay of a plaintiff in prosecuting his suit for infringement of copyright before a Master, to whom the proceeding has been referred, invalidates the claim for damages. This decision was recently made by the Circuit Court of Appeals for the Second Circuit in the case of D. O. Haynes & Company, Plaintiff-Apellee, versus The Druggists Circular, Defendant-Apellee.

Nine years had elapsed between the first hearing before the Master and a continuation of the hearings before him. Long lapse of time has been held sufficient of itself to prevent relief. Merely instituting a suit does not relieve a person from the operation of the rule of laches, for if he fails to prosecute his suit diligently, it is the same as if no suit had been begun. Laches is defined by the court as meaning neglect for an unreasonable and unexplainable length of time under circumstances permitting diligence, to do what in law should have been done.

Long neglect to take advantage of leave given by a court to assert a right by bill or cross bill may bar the right to file it, and the right to enforce an order of the court may be lost by laches. The doctrine is peculiar to courts of equity, for "he who seeks equity must do equity," and he must "come into a court of equity with clean hands."

"The power of a court of equity is invoked upon the basis of nothing less than conscience, good faith, and reasonable diligence. Chancery courts should not grant aid to a litigant who has negligently slept on his rights and suffered his demand to become stale, particularly where injustice would be done by granting the relief asked," according to the decision.

Foreign Rights to Patents and Trademarks

"PIRATING" of trademarks and patents held by United States citizens has been mentioned in this department upon several occasions. From the numerous appeals received by the Bureau of Foreign and Domestic Commerce as to the procedure advisable against those who are usurping commercial property in foreign countries, it would seem that the necessity for properly protecting trade symbols and patents abroad can hardly be overestimated.

In most countries of Europe and Asia, the original user of a trademark is entitled to it, as in the United States and Great Britain. In the countries of Latin America, the right of exclusive use is usually obtained by registration, regardless of whether the registrant was the first user of the mark. The establishment of the Inter-American Bureau, one of the most commendable activities of the Pan-American Union, will undoubtedly tend to improve the situation in connection with commercial property

rights in the various American republics. Numerous cases of infringement have recently been noted in press dispatches, illustrating the too-common tendency to profit by the negligence of owners of valuable commercial property rights.

In Cuba recently the product of an American firm had become so well known that when the firm tried to obtain registration of its trademark the Cuban authorities would not grant the registration on the grounds that the particular mark had become a byword in most homes in Cuba and therefore was not subject matter for trademark protection.

Potential markets are frequently overlooked by manufacturers, and later when an attempt is made to develop the market it is found that the trademark is legally registered as the exclusive property of another person. The confusion resulting from a wide variance in registration methods and different fees can be effectively unravelled only by attorneys qualified in foreign procedure and practice.

Before inventors decide to obtain foreign patents, it is well to investigate the requirements of making, marketing, and disposing of the product within the time specified in the countries wherein protection is sought. The liberal patent laws of the United States are very different from those in most foreign countries. The American patent system is the friend of the poor inventor: no tax is assessed on the patent, contrary to the practice in almost all foreign countries; the inventor is not required to manufacture or offer his product for sale, and he can placidly "sit tight," refusing to permit the public to benefit from his invention for the 17 years that his patent rights remain in force. In many countries, the patent right is forfeited by such inactivity, or for non-payment of the patent tax.

No person or firm is liable for infringement of a United States patent unless the complete infringement has been effected in this country; that is, if all but one of the parts of a patented device are made in this country, and shipped to another country for assembly and the addition of the remaining part, there is no infringement unless the rightful owner of the patent has taken out foreign patents. Devices patented only in this country have been made in other countries and smuggled into the United States for sale here, but if the vendors or users of the infringing devices can be located, they are liable as infringers. The patent franchise grants to the owner the right to exclude everyone else from making, using, and vending the article patented, without the permission of the patentee, in the United States. That is the extent of his monopoly.

Yeast Patents Awarded on Appeal

FOR a process of enclosing particles of yeast in milk solids, rather than in gelatin and similar substances used in the

prior art, Baylis M. Dawson was awarded a patent upon appeal from the decision of the patent examiner. The examiner had ruled that the applicant had merely followed the teachings of the prior art, in the application of spray drying to the yeast and milk mixture and the selection of milk in place of gelatin because of its higher nutritive value, and that this was not invention but only an obvious expedient such as might be expected of one skilled in the art.

The Board of Appeals refuted this decision, for the reason that it considered the claims justified because the milk increases the nutritive value of the composition as a food product, and acts as a food for the yeast organism. Moreover, the Board upheld the appellant's statement in his specification that milk solids are peculiarly adapted to act as the protective or encapsulating substance for the viable yeast particles, in that they permit dessication of the mixture without injury to the yeast cells.

Certain claims were rejected, including several covering a composition consisting essentially of yeast particles encapsulated or covered by malt extract solids. A prior patent was cited, showing that malt had been listed as a suitable substance to mix with yeast to form a dry yeast composition.

Another patent was awarded to Dawson, consisting of yeast encapsulated with fruit juices instead of, or in addition to, the milk solids mentioned in his other patent. Malt extract solids as an encapsulating material for a comminuted and substantially dry yeast composition were considered old in the art, but the addition of fruit juice to the malt extract solids as an encapsulating material was held to be new.

Inter-American Trademark Bureau

IN compliance with the terms of the Protocol on the Inter-American Registration of Trademarks, signed on February 20th, by most of the countries having membership in the Pan-American Union, there is to be established an Inter-American Trademark Bureau located at Havana, Cuba. It has also been specified that the Bureau shall publish a periodic bulletin providing data and information concerning registration of trademarks and commercial names in the various American countries.

Prior to the signing of the Protocol, the signatories adopted the provisions of the General Inter-American Convention for Trademark and Commercial Protection. The following statement from the draft of the Convention will show its purpose.

"Considering it necessary to revise the 'Convention for the Protection of Commercial, Industrial, and Agricultural Trademarks and Commercial Names,' signed at Santiago, Chile, on April 28, 1923, with a view of introducing therein the reforms which the development of law and practice have made advisable; animated by the

desire to reconcile the different juridical systems which prevail in the several American Republics; and convinced of the necessity of undertaking this work in its broadest scope, with due regard for the respective national legislations, (we) have resolved to negotiate the present convention for the protection of trademarks and trade names, and for the repression of unfair competition and false indications of geographical origin."

The new convention provides for equality of citizens and aliens as to trademark and commercial protection in all of the countries signing the pact and outlines regulations for the protection of trademarks and commercial names, and for the repression of unfair competition or false indications of geographical origin and source.

The protocol provides for the establishment of a permanent Inter-American Trademark Bureau, and specifies the procedure to be followed in registering trademarks and commercial names in all of the states concerned. Both the convention and protocol were signed on February 20th by the representatives of the governments of Peru, Bolivia, Paraguay, Ecuador, Uruguay, Dominican Republic, Chile, Panama, Venezuela, Costa Rica, Cuba, Guatemala, Haiti, Colombia, Brazil, Mexico, Nicaragua, Honduras, and the United States. Those desiring copies of the Convention and Protocol may secure them from the Bureau at Havana, Cuba, or from the Pan-American Union, Pan-American Building, Washington, D. C.

Geographical Term Allowed in Trademark

REVERSING the decision of the examiner, who had held that "Semet-Solvay Coke" could not be registered as a trademark because "Solvay" is the name of a town and "Semet" is the name of an individual, the Assistant Commissioner of Patents ruled that the registration was allowable in view of the fact that the words were not reasonably well known as a geographical term and as a surname.

Although there is a village in Onondaga County, New York, which bears the name of Solvay, it was held that it is not a reasonably well known geographical name, as contemplated by the statute. In support of this contention, it was noted that the word "Lakeside" was not considered sufficiently well known as a geographical term to bar its use in a trademark, despite the fact that the word "Lakeside" appears in the Postal Guide as the name of 16 or 17 post offices, and was found to be the name of two incorporated towns of the United States.

The word "Semet" is not generally recognized as a surname. The examiner cited an instance where it appeared as a surname in the St. Louis Directory for 1924, but admitted that it did not occur in the current telephone directories or general directory for the City of New York, nor in the 1928 directory for Washington, D. C. Individually non-registerable words cannot be used in a trademark when in combination, but the decision of the examiner was reversed and both words were allowed.

Capitalism and the Patent System

CAPITALISM—the foundation of the present civilization—is sometimes heralded as the mother of invention. But invention is older than the human race, and capitalism dates from the establish-

ment of the patent system. Under the system, the individual is awarded a temporary monopoly for his creation, whatever it may be, in exchange for exposing his idea to society with instructions which will enable society to practice it and benefit by it. Like Christianity, and the older religions, the essential part of the patent system is the guarantee of a "just reward" for a meritorious accomplishment.

The poets and the philosophers have pictured a perfect state, "where no one shall work for money, and no one shall work for fame." But it is significant that even in the Soviet States of Russia, the capitalistic patent system is accorded an important place, despite their obvious attempt to establish the ideals of communism, or at least socialism. Man seems to have learned that although the desire to create is primary, it is irrevocably allied with the desire for wealth and power and fame. It is also significant that few of the creative contributions which have improved the status of mankind have come from races or individuals who scorn luxury and power. Apparently man does not properly function without the promise of a "just reward."

"What is it that makes the United States a great nation?" asked the Japanese, after Commodore Perry had opened the ports of Japan and the people there began trying to become a great nation. In the words of their Mr. Takanshi, "We looked about us to see what nations are greatest, so we can be like them. There is the United States, not much more than 100 years old. We said, 'What is it that makes the United States such a great nation?' and we investigated and found that it was patents, and so we will have patents."

In the absence of a patent system, corporations could not find the capital to exploit new inventions. Capitalists would not risk such large amounts of money if after a machine is perfected, other manufacturers could copy the perfected machine without undergoing the tremendous preliminary expense. It is the protection to the investment, assured by the patent, that enables investors to get a profitable return for the money they have risked.

Mr. Julius Barnes, former president of

the United States Chamber of Commerce, has pointed out that America's predominant industrial position and American ability to pay higher wage scales than other countries rests largely upon our superior invention and patent protection.

"A tool is but the extension of a man's hand," said Henry Ward Beecher, "and a machine is but a complex tool. He that invents a machine augments the power of a man and the well-being of mankind."

Rotarians Guard Their Name

IT is a privilege to use the name "Rotary" on cigars, and that privilege is held by a certain firm licensed to make and sell its tobacco products principally to members of the Rotary Club. This was made clear in a recent decision of First Assistant Commissioner Kinnan, in which he held that Gallagher, Limited, of Belfast, Ireland, is not entitled to register the word "Rotary" as a trademark for tobacco, cigars, and cigarettes.

Although the applicant had registered its trademark in England, the petition was denied here on the ground that the Rotary Club of Chicago had been incorporated prior to the date of the cigar manufacturer's application, and the Rotary Club had arranged with a certain American manufacturer for the use of the word "Rotary" on cigars and tobacco products made principally for the use of Rotarians. The law does not permit registration of any name adopted by an institution, organization, et cetera, incorporated in any state of the United States prior to the date of adoption and use by the applicant.

As interpreted by the First Assistant Commissioner, the "use by the applicant" means use in this country. It is held that use by the applicant in a foreign country, and the registration of his trademark there, cannot avail him of the privilege of using the same trademark in this country. If additional proof of the damage to the Rotary Club had been needed, it was pointed out, the evidence showed that the use by the Rotary Club of the word "Rotary" on cigars and other tobacco products would furnish such additional proof of damage.

Patents Recently Issued

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Pertaining to Aeronautics

BRAKE FOR AIRPLANES—A drag brake normally affording no projection beyond the under surface of the fuselage, but having means to throw the brake into ground engagement to resist forward movement in landing the plane. Patent 1710628. John H. Kessler.

Pertaining to Apparel

SHOE—Of the turn type, including a shouldered sole shank through which a single seam is formed connecting both sides of the upper to the sole, thus producing a more snugly fitting and stronger shoe. Patent 1709735. Frank Parlante.

NECKTIE CENTRALIZER AND HOLDER—By which a cup-shaped member co-operates with the collar button, hiding the button from view and holding the tie in correct position, while an elastic neck band secures the tie in place. Patent 1708607. Charles J. I. Devlin.

Chemical Processes

LUBRICATING MIXTURE AND PROCESS OF MAKING SAME—An emulsion, consisting of mineral oil and the aqueous extract of the mucilaginous bark of *Ulmus fulva*, may be used in internal combustion engines, will adhere to the metal and greatly reduce friction. Patent 1708058. Preston C. Goss.

CARROTING ANIMAL HAIR AND WOOL—By the application to the skin of a 6-10 percent aqueous solution of peroxide of hydrogen and 1-2 percent of bismuth, cobalt or cerium in salt solution, the skin is then dried and ready for further working. Patent 1710565. E. Rich Bohm.

PROCESS FOR THE MANUFACTURE OF THERAPEUTICALLY-ACTIVE IRON PREPARATION HAVING YEAST AS ITS BASIC SUBSTANCE—Consisting in introducing a colloidal basic iron salt solution into yeast suspended in water, separating the solid substances by filtration, and drying them. Patent 1710584. Cornelius Masatsch.

Designs

DESIGN FOR A PENDANT FOR WEARING APPAREL—Patent 78162. Martin A. Klein.

DESIGN FOR A DRESS—Patent 78214. Dorothy Long.

DESIGN FOR A LACE DOILY—The inventor has been granted two patents for ornamental designs. 78254 and 78255. Ben A. Ball.

DESIGN FOR A BATHING SUIT—Patent 78399. Dorothy Long.

Electrical Devices

AUTOMATIC SIGNALING APPARATUS—A manually controlled electric system giving an audible or visual sign in large commercial businesses where it is necessary to call heads of departments visiting various points at a distance. Patent 1707909. Jacob Gullong.

HEATING SYSTEM—An electric heating means whereby the various rooms of a house may be quickly and individually heated to a certain temperature, and the heat regulated and automatically shut off at a predetermined degree. Patent 1708580. Raymond C. Kerlauezo, Llewellyn W. Evans, and Seward B. Merry.

DEVICE FOR INDICATING OSCILLOGRAPH CURVES AS STATIONARY—Whereby variations in electrical quantities such as voltages or currents, may be observed, and several waves or half-waves may be centered upon a fluorescent screen without distortion. Patent 1707594. Frederick Bedell.

CONTACT SCREW—Comprising a pair of insulating members, a contact point and a fuse wire, which is simple in construction and may be readily applied to any standard house lighting circuit. Patent 1707589. Roy H. Williams.

FADING AND STATIC ELIMINATING RADIO ANTENNA—Comprising a split ring magnet, a current carrying winding around said metallic ring and a second winding completely enclosing the ring, and a pair of permanent magnets at opposite sides of the ring. Patent 1710085. George W. Cooper.

Of Interest to Farmers

POULTRY FEEDER—Wherein a guard will readily accommodate itself within a feed hopper and will prevent the fowls from scattering the food, the device may be readily removed for cleaning the trough. Patent 1708838. Clarence E. Hedrick.

COMBINED HAY RAKE, STACKER AND LOADER—An attachment for tractors operable by the power derived from the vehicle, for lifting hay, alfalfa or other cut grass so that it may be manually dumped onto a wagon, or for stacking the same. Patent 1710632. Otha E. Main and Clarence C. Waughop.

SANITARY POULTRY FOUNTAIN—So constructed that the reservoir and drinking pan may be easily connected for regular use, or readily separated for cleansing, and may be nested to occupy but little space in shipment or storage. Patent 1711366. Arthur J. Tool.

Of General Interest

DISPLAY STAND—Constructed to display a large number of articles simultaneously in such manner that they will be visible individually yet securely held against surreptitious removal. Patent 1707895. Raymond O. Berke.

CLEANING DEVICE—Through which liquids are adapted to be passed and screened to eliminate foreign matter, means being provided to maintain the screened openings clean to maintain a constant flow of the liquid. Patent 1707846. Levin O. Corkran.

STAY FOR WASHABLE RUGS—In the form of light metal edging strips which permit the rug to remain flat when in use on the floor, but may be easily removed for storing or washing the rug. Patent 1706672. William B. Mason.

CARD CARRIER FOR VISIBLE CARD INDEXES—Comprising a body and a heel member with a central perforation adapted to engage a guide, for general filing purposes, and comparatively more compact than the usual form of card. Patent 1707917. Luigi Lombardini.

CLEANING DEVICE FOR EYEGLASS LENSES—Comprising a pair of cleaning elements supported in juxtaposition to the lenses, removably associated to allow for renewal of the elements, and movable simultaneously to allow for cleaning both sides of the lenses. Patent 1708728. John J. Kilbride.

SEWAGE-DISPOSAL SYSTEM—A series of cells designed to receive and automatically promote the spontaneous reduction, and sanitary disposal, of sewage through the agencies of anaerobic and aerobic bacteria always ready to develop under proper conditions. Patent 1708864. Ray M. Birnbach.

VENTILATOR—Which may be readily attached to a window for allowing fresh air to enter the room, but will exclude rain, and forceful blasts, and will divide the air in a manner to prevent drafts. Patent 1708841. Albert R. Laubenstein.

FOOD CHOPPER—For cutting food by hand, the chopper presents a large amount of cutting edge which may be entirely disassembled and the parts taken separately for polishing, cleaning, or sharpening the cutting edges. Patent 1707563. Anna F. Nauman.

WATCHCASE—Which is the combination of a watchcase and fountain pen cap, in which the watchcase includes mating sections adapted to the associated with the pen cap to constitute a closure. Patent 1709700. William Wishinsky.

SANITARY CONTAINER—For tooth brush or other article, having a cap which acts as a container for sterilizing material, and permits escape to the interior of the receptacle when closed, but cuts off escape when removed. Patent 1709625. Harry Martin.

HAIR-WAVING DEVICE—Comprising a series of interconnected cross sectionally convex members whereby a waving or marcelling of the hair may be produced in a well defined and lasting manner, without injury, or tearing the hair. Patent 1709693. Martha A. Tienken.

SHINGLE CONSTRUCTION—In the form of a composition shingle having tongues and slots for locking the same, thereby preventing curling, while keeping the tongue itself locked, and thus producing a smooth roof-structure. Patent 1709776. Abbott Coburn.

BEDCOVER - HOLDING DEVICE—Whereby clamps and adjustable members are attached to the bed spring frame providing securing means for the blanket and other bed covering to prevent the same pulling loose at the sides and foot of the mattress. Patent 1709275. Benjamin A. Moeller.

VALVE BOX—Comprising a lower section in the form of a sleeve, and an upper section telescoping within the lower section and adapted to be interposable between a subterranean pipe line and the surface of the street. Patent 1710571. Natale Forni.

MAP HOLDER—Wherein a container is formed with a transparent face for the reception of a sheet or folded map, and a manually actuated pointer is associated with the cover for shifting from one point to another. Patent 1710555. Salvatore Tascarella.

MAILABLE MATTER OF ENVELOPES—Having temporary connecting means whereby they are integrally joined together so as to form substantially a continuous sheet, whereby a typist may easily address them, and they may be moistened and sealed in short time. Patent 1710603. Stella Benenato.

ICE - CREAM - FREEZING CYLINDER—A refrigerating construction by virtue of which the freezing mixture may circulate rapidly and continuously so as to shorten the freezing time and thereby lessen costs. Patent 1710648. Emery Thompson.

COMBINATION FURNITURE—More particularly a combination desk or table and chair, which may be folded into small compass for transportation or storage, readily portable, and particularly useful in army, or field service, or rural schools. Patent 1711373. Abelardo De A. Casanova and Octavio A. H. Posada.

SMOKING PIPE—Having at the bottom of the bowl a chamber for collecting saliva, which may be readily cleaned, the smoke passage through the stem being entirely independent, and out of communication with the saliva chamber. Patent 1711435. Kenneth M. West.

DRIER AND STEAMER FOR TUBULAR FABRICS—An assemblage consisting of a drying shell, means for drawing the fabric over the shell inside a drum and an inlet and outlet for the drying air, thereby effecting the steaming and drying in one operation. Patent 1711094. Maurice M. Kasanof.

Hardware and Tools

COMBINATION DOOR HINGE AND CHECK—In which pneumatic means and spring means are associated in a unitary device to effect a noiseless closing with a minimum strain on the device in order to maximize its durability. Patent 1706656. Nathaniel T. Collins.

FILE HOLDER—For supporting a flexible file so that it can be manually actuated with accuracy and adjusted to adapt itself to the shape of the object to be operated upon. Patent 1707207. Valentino L. Bianchi and George A. Holsberg.

BOLT, SHAFT AND THE LIKE—Comprising a helically wound resilient member which is tubular in form and capable of expansion and contraction, dispensing with lock nuts, the bolt itself exerting a pressure to hold the parts coupled. Patent 1708793. Allan H. Jones.

DOOR LOCK—Having a latch bolt capable of actuation from either side of the door, a locking member operable to prevent actuation of the outer knob, and a key for operating the bolt from the outer side. Patent 1707413. Kenneth A. Pendleton.

ROTARY UNDERREAMER—For increasing the diameter of a well after the usual reamer increases the depth, by forcing cutting blades into the wall simultaneously with the advance of the reamer which increases the depth. Patent 1710580. George F. Le Bus.

BAND SAW AND PULLEY THEREFOR—Which affords a uniform support and tension as the cutting edge of the saw is worn down and its width decreased, and maintains the saw in its proper operating plane and against slippage. Patent 1711374. James J. Chapman.

DEVICE FOR HOLDING MOLDINGS—A support for a molding during the cutting or planing operation, which is capable of such adjustment that it may be made to fit all points of the surface and will prevent vibration or misalignment. Patent 1711342. Russell G. Dishman.

SECURING MEANS FOR CORRUGATED BUILDING SHEETS—Consisting of a clamp generally of U-form which provides a support beneath the

corrugated sheets effecting a stronger and more secure attachment, easy of application, light in weight and of comparatively low cost. Patent 1711415. Louis Lane.

Heating and Lighting

APPARATUS FOR ALTERING THE SHAPE AND SIZE OF A PROJECTED BEAM OF LIGHT—Particularly adapted to be used in an optical projection machine, and including adjustable shields for illuminating a field of vision or a particular object from a distance with a projected beam of light. Patent 1709626. Harold A. McGunnigle.

FURNACE USING FORCED DRAFT—Having automatic means for controlling the air blast in response to the steam pressure, collecting the unburnt gases and returning them to the fire box, and reducing the consumption of fuel to a minimum. Patent 1709800. Elmer A. McArthur.

Machines and Mechanical Devices

OUTBOARD MOTOR—Of the twin screw type, embodying a two cylinder two cycle balanced stroke engine driving the two screws with materially less vibration than is commonly found in operating a single screw. Patent 1707897. Gaston Bizet.

STAPLING MACHINE—For cutting blanks from a strip of material, forming staples and setting the same, will form an appreciable great number of staples without refilling, and is practically immune from clogging. Patent 1708730. Alexander Z. Kruse.

THROW-OFF DEVICE FOR VIENNA-ROLL-FORMING MACHINE—Wherein a series of dies are adapted to make imprints on the rolls while in the form of dough, and the rolls are automatically ejected immediately after being formed. Patent 1708758. Charles Gottfried.

EDGE-TRIMMING MACHINE—A single instrument for cutting the grass and plowing to a certain extent some of the soil adjacent thereto, so as to present a clean edge between the lawn and the walk. Patent 1708768. Albert W. Marsik.

CABLE-OPERATING MACHINE—Wherein pairs of coating jaws make use of a relatively small force to produce a strong pull on an associated cable, and prevent slipping, in yarding logs and hoisting heavy objects. Patents 1708880. Cecil Gross.

FRUIT AND VEGETABLE WASHING AND DRYING MACHINE—In which the fruit or vegetables are washed by a spray as they are discharged into a revoluble hopper, which is subsequently rotated to dry the fruit or vegetables by centrifugal action. Patent 1708721. Joseph T. Evans.

APPARATUS FOR TREATMENT OF DECIDUOUS FRUIT—For thoroughly removing or neutralizing all traces of arsenate of lead from the fruit, so that when subsequently washed and dried, the fruit will be clean and ready for the market. Patent 1707610. August Guignard, August Bosse and John Guignard.

FLOOR-POLISHING MACHINE—Which may be operated, when necessary, to vary the degree of vertical pressure exerted by the brushes upon the floor, provides easy access to the working parts, and protects the operating mechanism. Patent 1707575. Henry E. Schooling.

FITTING—For boilers, comprising coupling members having axial openings and opposed seats, a ball mounted in said seats, composed of semi-spherical sections, having semi-cylindrical opening, whereby a three-way fitting is provided. Patent 1709624. Alva A. Lindley.

SCUM ELIMINATOR—Adapted for use in the manufacture of cane sugar, to aid in separating from the cane juices, and carrying off, that portion of the matter in suspension which is lighter than the juice. Patent 1709783. James C. Etheredge.

DEVICE FOR FORMING MULTICOLORED, BRAIDLIKE DECORATIONS—A device for causing

the twirling and ejecting motion of a plastic substance, and regulating the degree of tension, thereby giving the desired pitch of the strands to produce a decorative braid-like form. Patent 1709280. John A. Ost.

REFRIGERATOR AND DISPENSING DEVICE—A rotatable storage device for maintaining a plurality of bottled liquids in a cool condition, the bottles being placed in an accessible position by the insertion of a coin and the manipulation of a rod. Patent 1710621. John E. Henderson.

SAND-TESTER PUMP—Which may be raised or lowered by the drill pipe for forcing fluid from the sand, and in which a suction is created to remove mud and water from the sand. Patent 1710581. George F. Le Bus.

LIQUID-DISPENSING APPARATUS—Particularly for use at gasoline filling stations, there being an arrangement whereby various quantities of gasoline are stored ready for immediate dispensation for a given amount of money, the fluctuation in price being taken into account. Patent 1711331. Thomas B. Smith.

ARTICLE-SHAPING APPARATUS—By pressure of air and an expandable die with which a plunger cooperates to compress air in a receptacle and forces the walls against the faces of the die to shape the article. Patent 1711445. Benjamin Burveniek.

MECHANICAL AID FOR READING AND WRITING—A desk which is vertically and angularly adjustable, together with rests for both arms, whereby the user will be helped to remain in upright position so that the eyes will be correctly focused while reading or writing. Patent 1711360. Vadakkath R. Menon.

Medical and Surgical Devices

SYRINGE—Including a barrel, a piston movable therein, a hollow piston rod, a manually controlled plunger valve and yieldable rubber rings which eliminate the necessity of packing, and provide a leak-proof structure. Patent 1707880. John H. Sheets.

Prime Movers and Their Accessories

LINER FOR VALVE SEATS—Adapted to be inserted in a recess in the intake or exhaust passage of a cylinder block, after said passage has been re-bored, to form a recess with beveled edge to properly seat the valve. Patent 1709807. Theodore S. Purnis.

HUMIDIFIER FOR INTERNAL-COMBUSTION ENGINE—Adapted to be attached to an old motor or built into a new one, for delivering steam, in small quantities thereby enriching the mixture, giving more power, and a smoother-running motor. Patent 1711408. Frank H. Fritz.

Pertaining to Recreation

PLAYGROUND APPARATUS—Permitting the healthful exercise of children, which includes units presenting horizontal climbing rungs, and a sliding member supported thereby, may be readily erected and transported in a knock-down condition. Patent 1707854. George J. Hanlon.

PLAYGROUND APPARATUS—Which includes a horizontal ladder, diagonal ladders, an elevated platform and a slide, all combined in a minimum of space and in a manner to render the apparatus safe and amusing for children. Patent 1708883. Frank B. Hedges.

STUFFED FIGURE TOY—So constructed that it will have no breakable parts to penetrate the cover, the body and limbs being yieldable and flexible yet sufficiently rigid to remain in the position placed. Patent 1708170. Hasseltine M. Dickens.

AMUSEMENT DEVICE—Comprising a plurality of multi-faced members which may be matched together to form a number of complete pictures or representations of an object, which is of educational value as well as entertaining. Patent 1709660. Joseph de Bracht.

GAME APPARATUS—A target simulating a natural head having teeth in an opening, the object being, in exercising skill at throwing, to knock out as many teeth as possible, with an allotted number of balls. Patent 1709420. Charles Weissner.

FIGURE WHEELED TOY—Embodying a cart and a walking figure arranged to simulate pulling the cart, wherein the legs and other movable parts of the figure will possess life like movements when pulled over a plane surface. Patent 1711376. Edward J. Darling.

Railways and Their Accessories

EXPANSION RAIL JOINT—By means of which the abutting ends of rail sections may be securely held down to their tie, or other base, against lifting or spreading, while permitting relative longitudinal expansion and contraction therein. Patent 1710557. Victor Walker and Philip Kaplan.

Pertaining to Vehicles

TIRE-RIM-CONTRACTING DEVICE—Which will hold the rim in contracted condition while the tire is being removed and replaced, and until released to return to its normal condition. Patent 1700719. Samuel H. Savage, 540 34 St., North Bergen, N. J.

ACCELERATOR—Including a base and a pedal for operating the accelerator of an automobile, the device is simple and adapted to be employed by the owner. Patent 1700643. Carl Nordell.

VENTILATOR—A combined buffer and ventilating device, comprising a channel-shaped shield adapted to be connected with, or part of, the sliding sash of a closed vehicle, to permit ventilation but prevent rain from entering. Patent 1707888. John S. White.

ACCELERATOR PEDAL—Which may be readily attached to an automobile, and when in operative position provides an easy and comfortable foot rest which will maintain a non-frictional contact with the accelerator button. Patent 1708820. Charles B. Wright.

ROTARY ANTISKID CHAIN FOR VEHICLE WHEELS—Easily applied to or removed from one of the road wheels, to carry an endless antiskid chain encircling the wheel and a spool to set up a more effectual anti-skidding action. Patent 1708755. Charles H. Dierksmier.

JACK—For use with automobiles, in which the turning movement is multiplied to impart a rapid and maximum lifting from relatively short members, so that the jack when collapsed will occupy small space. Patent 1708717. Sydney P. Barker.

DIRECTION INDICATOR—A hinged signal, a reciprocating piston operating subject to the suction of the engine, and a valve control within reach of the driver, for retaining the signal in active position during the movement indicated. Patent 1708606. John Clifford.

SAFETY DEVICE FOR AUTOMOBILES—A combination structure whereby the gas and ignition are both turned off, and the hood locked closed by a single operation, thus eliminating key losses, and preventing theft of the car. Patent 1709717. John P. Geraghty.

AUTOMOBILE SIGNAL SWITCH—Having means for signalling either right or left hand turns, the switch mechanism operating either an audible or visible signal, or both, whenever the driver swings the wheels any material distance in either direction. Patent 1709806. Honorino Pereira.

INSTRUMENT FOR GAUGING THE RATE OF ACCELERATION OR DECELERATION OF VEHICLES—A light case supported on a pivot and partly filled with liquid, the transference of the liquid, by its weight, from one part of the case to another, indicating the rate of acceleration or deceleration. Patent 1710594. William Tapley.

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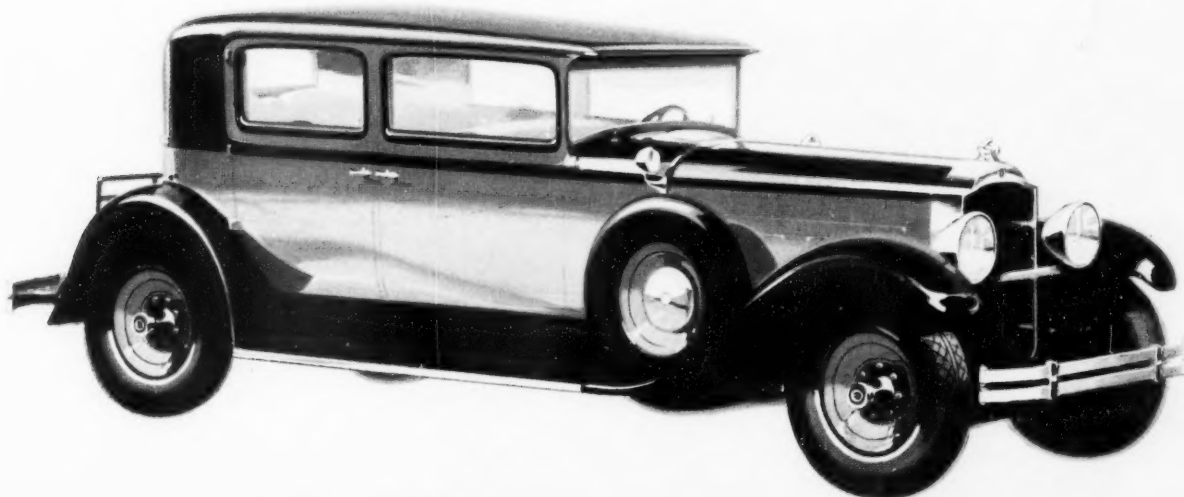
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